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THE SYMPTOMATOLOGY, DIAGNOSIS, AND SURGICAL TREATMENT OF CERVICAL RIBS.

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I had never seen a case of recognized cervical rib until October 20, 1905. Within less than a month, personally or through Drs. Hearn, Patterson, and Taggart, of the surgical department of the Jefferson Medical College Hospital, I saw four other suspected cases, of which two proved not to be cervical ribs and two others were. Of the last two, only one needed operation (Patterson's). The history of the patient operated on by myself is as follows:

Mrs. M. A. R., aged sixty-three years, entered the Jefferson Hospital October 20, 1905, at the request of Dr. F. R. Brunner, of Eshback, Pa., who kindly furnished me with the following facts:

Her father died of some disease of the heart and her mother of typhoid fever. Nine brothers and sisters are living and well.

In childhood, she had measles, mumps, whooping-cough, chicken-pox, and scarlet fever, and at the age of twenty-three years, typhoid fever. From all of these she made good recoveries. She has had several attacks of rheumatic fever. She was married at thirty, and has had one child. Her general health has been very good.

At the age of seventeen years she noticed a lump above the left clavicle. Although its presence did not cause her any trouble, she consulted a physician, who told her it was a "bone." She never had any trouble from it until last February, when, upon rising in the morning, she noticed that the first and second fingers of the left hand were the seat of sharp stinging pain, and that they were much

paler than the others and cold to the touch. Brisk friction for a few moments would cause these symptoms to disappear. About a week later the thumb and the remaining fingers also became involved. A few days later she complained of a constant sharp stinging pain in the left hypothenar eminence. In the course of a few days this pain extended up the ulnar side of the forearm to the elbow, the radial side becoming involved soon afterward. Later, the pain extended up the arm to the shoulder. It was so severe as to cause her to lose considerable sleep. With the onset of the pain, the left

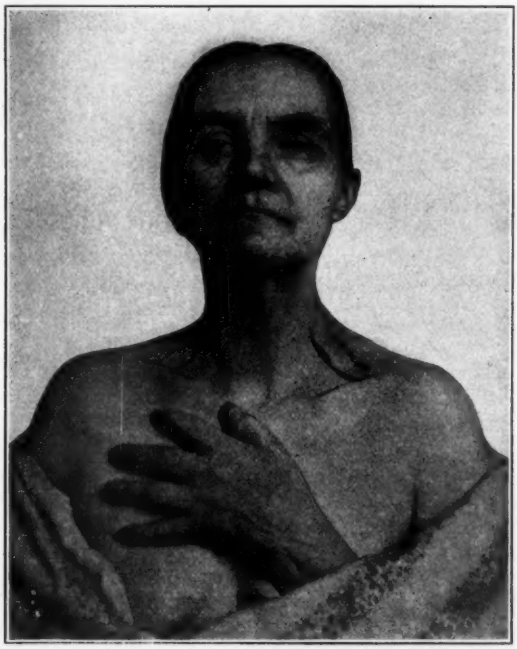


FIG. 1.—Photograph of Keen's case of cervical ribs. The obliquely horizontal lines correspond to the clavicle. The double obliquely vertical lines correspond to the subclavian arteries. The gangrene of the finger-tips shows imperfectly.

hand became distinctly less red than the other. During last June the pain gradually disappeared. About the first of September, she again noticed a tingling sensation and shooting pain in the finger-tips of the left hand, and that the fingers were red and slightly swollen. About two weeks later the soft parts at the tips of the fingers, especially under and about the nail, became gangrenous in the following order: index, ring, thumb, middle, and little finger. She stated that the pain was always less severe while she used the hand freely in her work.

Physical Examination on Admission. Weight 119 pounds. There is no arcus senilis present. There is a soft systolic cardiac murmur heard best at the apex. The lungs are apparently normal. There is no pulse whatever in the axillary, brachial, radial, or ulnar arteries on the left side. The left subclavian can be felt above the left clavicle running downward and outward to the clavicle for a distance of 6 cm. (Fig. 1). Its width as ascertained by putting one finger upon each side of the vessel, and including, of course, two layers of skin and subcutaneous tissue, is 18 mm. It pulsates very strongly to the touch. Though there is no thrill, a stethoscope applied over the artery reveals a local bruit which is not propagated. Behind the artery is a rounded swelling above the left clavicle a little internal to the junction of its middle and outer thirds. On deep palpation this swelling is found to be part of a hard bony mass which can be traced backward to the spinal column. As it curves forward it seems to pass behind the clavicle. The artery passes in front of (that is, over) this bony prominence, which was diagnosticated as a cervical rib.

The left hand is distinctly cold and very much paler than the right. The nail of the middle finger is entirely loose and there is an ulcerated surface corresponding to the site of the nail, passing through the tip of the finger midway between the dorsal and the plantar surfaces. The other four nails are discolored and the tips of the fingers are somewhat ulcerated, the worst being the ring finger. This ulceration is the result of the sloughing off of the slight gangrenous patch from the subungual space (Fig. 1).

A slight bruit can be heard over the right subclavian, but it is much less distinct than that over the left. There is no thrill on either side.

Behind the right subclavian artery also a cervical rib is present and can be traced back to the spine. Both of the cervical ribs are immobile. A skiagraph (Fig 2) shows bilateral cervical ribs, the left being the larger rib.

The right subclavian artery also runs much higher than is usual and can be traced upward from about the junction of the middle and outer thirds of the right clavicle for a distance of 3.5 cm. Its width, measured as already estimated on the opposite side, is 15 mm. These measurements for the diameter of the vessels naturally should not be taken too exactly. The pulse on the right side is normal. The muscles of the left shoulder and the entire arm are considerably wasted. This is due in some measure to non-use of the hand, for all of the joints of the fingers, from having been kept of late quiescent and part of the time poulticed, have become partially ankylosed.

The right arm at the middle of the biceps measures 24.5 cm.; the left arm, 24 cm.; the right forearm, 8 cm. below the external condyle 20 cm.; and the left forearm, 8 cm. below the external condyle 18 cm.

Neither inspiration nor elevation of the right arm has any effect upon the pulse. The urine is normal except for a rather low percentage of urea.

Dr. Alfred Gordon kindly examined her, and confirmed the above findings and also found marked tenderness and hyperalgesia

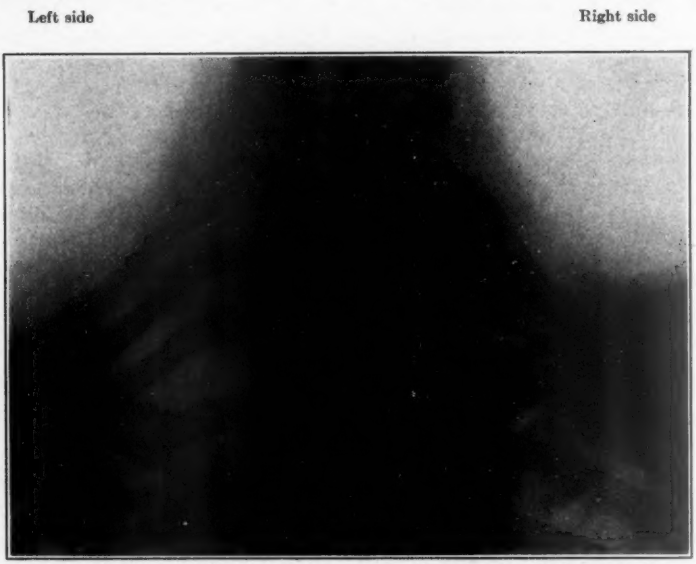


FIG. 2.—Skiagraph of Keen's case, showing bilateral cervical ribs, the left being the larger and higher and the only one causing symptoms.

FIG. 3.—The piece of rib removed in Keen's case (natural size). Note the knob at about its middle. This formed the tumor felt behind the subclavian artery.

in the hand. Sensation in the arm and forearm is very slightly diminished. The temperature sense is normal.

Operation November 29, 1905. An incision just above the left clavicle and parallel with it, a second vertical incision directly over the tumor, and dissection of the internal and external flaps,

gave ready access to the tumor. This was found to consist of the subclavian artery and immediately back of it a cervical rib—attached to the seventh cervical vertebra and immovable. The attachment to the first rib just behind the middle of the clavicle was broad, and relatively thin, partly fibrous, but chiefly bony. The middle of the rib consisted of a large knob of bone (Fig. 3). The brachial plexus as well as the subclavian artery ran over the cervical rib. The cords of the plexus instead of being cylindrical were markedly flattened. By displacing the artery first inward, then outward, I was able to expose thoroughly the anterior end of the bone, to which part the scalenus anticus was attached, and to detach this muscle from the bone by scissors. Then displacing the artery internally and the nerves externally, I was able to uncover the

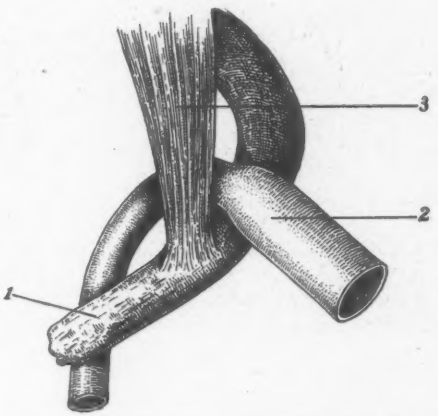


FIG. 4.—Keen's case. Sketch showing the marked increase in size of the subclavian artery after escaping from behind the scalenus anticus. 1. Cervical rib. 2. Subclavian artery. 3. Scalenus anticus.

posterior end and separate the surrounding tissues from it. With a pair of bone forceps I divided the bone posteriorly and anteriorly, removing the periosteum with it. The fibrous part of the anterior end was divided by scissors, the parts underneath being guarded by the handle of an instrument. I was particularly careful at this point, fearing every moment that I should tear the dome of the pleura. At no time, however, did I see the pleura nor was it injured, nor was the subclavian vein seen at any time. With a pair of rongeur forceps I then smoothed off the two ends of the bone. The artery where it emerged from behind the scalenus anticus seemed to be smaller in diameter than usual. It changed its course downward and outward abruptly by a sharp bend (Fig. 4). Immediately beyond the external border of the muscle it was dilated to nearly twice the

width of the vessel as it emerged from behind the scalenus anticus. Down to the point where it disappeared behind the clavicle it retained this enlarged diameter. Beyond that point it could not be followed.

A small cigarette drain was placed in the wound, which, after douching with salt solution, was closed by ordinary sutures. The patient was placed in bed in admirable condition.

In the afternoon of the operation her temperature rose to 100.6°. It was down to normal on the second day, and so continued until she went home. The cigarette drain was removed at the end of twenty-four hours, and the wound healed without note. I desired

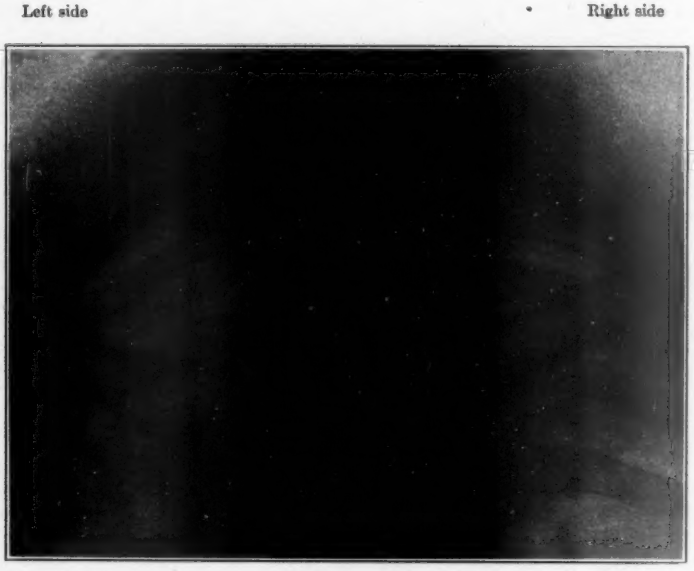


FIG. 5.—Keen's case. Skiagraph showing the gap in the cervical rib left by the resection Opposite A and B are seen the stumps of the two ends.

later to etherize her and break up the adhesions in the finger-joints so as to give her a more useful hand, but she was unwilling that this should be done.

Immediately after the operation all pain disappeared from the left arm, and remained absent up to the time when she left the hospital, twelve days after operation. The bruit still persisted in the left subclavian, but there was no thrill. Pulsation was less evident than before the operation. The pulse did not return in any of the arteries below the subclavian.

Within twenty-four hours after operation the left hand assumed a much better color, and in the course of two or three days its tem-

perature was almost the same as that of the right hand. Meantime the ulcerated spots on the fingers dried up and crusted over, so that she was no longer obliged to protect them even with a dressing.

A new skiagraph (Fig. 5) shows where the resection left a gap in the left cervical rib.

October 20, 1906. Eleven months after operation, Dr. Brunner reports that she does not suffer at all except from slight pain in the forearm when she works much. Her sleep is excellent. The subclavian is normal. There is very slight pulsation (?) in the axillary and ulnar arteries, none in the radial. The nail is absent only on the middle finger; the fingers are not painful. She cannot quite close them, but she uses her hand for all kinds of work, and it feels the same and is as strong as the other.

A cervical rib is a congenital vice of development. Unlike most other such defects, it usually exists alone. But it may be associated with other congenital defects. Thus, Ballantyne[1] mentions a case, a woman, aged twenty-two years, in which there was an imperforate vagina with distention of the uterus. Poland describes a case associated with club-foot. Borchardt, Oppenheim, Marburg, and Schönebeck mention cases associated with syringomyelia. Levi describes one with the symptoms of multiple scleroses; Spiller and Gittings published a case of progressive muscular atrophy of cervicobulbar type similarly associated. Most of these were defects of development of the central nervous system. I have not found any other defects either in the skeleton or the soft parts associated with cervical rib. Though the defect is congenital the symptoms, as I shall point out later, seldom develop early in life.

Most cases of supernumerary cervical rib are attended with very slight or more frequently with no symptoms whatever. In fact, the existence of the anomaly is often entirely unknown until discovered either by reason of some illness requiring examination of the neck, at a postmortem, or in the dissecting-room. It is often assumed that the specimens found in the dissecting-room have caused no symptoms. It is, however, by no means a certainty that they were without symptoms, for the clinical history of the cadavers is rarely known.

Although mentioned by Galen (see Hunauld) and other early authors, our real knowledge in reference to the existence of cervical ribs dates from the paper by Hunauld, published in 1742 (Fig. 6). In 1849, Gruber published a paper on "Cervical Ribs," and twenty years later, in a second paper, increased the number of known cases to seventy-six. He quotes the first two cases (Willshire and Huntemüller) in which the anomaly was recognized in the living. Three other cases recognized during life were added by Struthers,

[1] All the references are in alphabetical order at the end of the paper.

in 1875. In 1894, Pilling increased the number of reported cases to 139, of which nine had been recognized during life.

Since that time a large number of cases have been reported. Most of them are interesting only from the anatomical and embryological point of view.[2] These I do not propose to consider, but shall limit this paper chiefly to those which have been treated by operation, incidentally considering a few of the other cases which are of interest from the surgical point of view, either by reason of their symptoms, physical signs, or treatment. The appended list contains all the

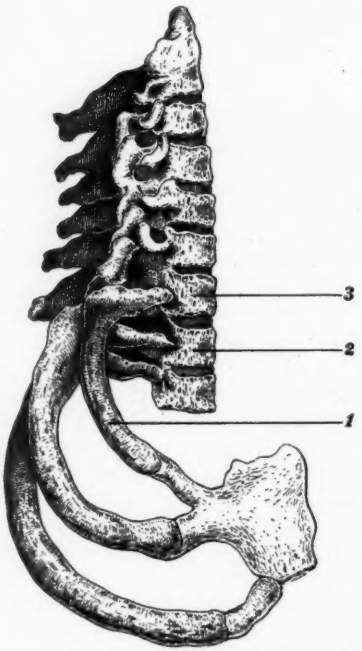


FIG. 6.—Showing a complete cervical rib. Cervical rib. 2. First dorsal vertebra. 3. Seventh cervical vertebra. (Hunauld.)

cases subjected to operation which I have been able to find, some of them from histories kindly furnished by the authors, to whom my thanks are due.

One of the chief reasons for the large increase in the number of cases reported in recent years is undoubtedly the discovery of the *x*-rays. In suspicious cases, examination by this method enables us to reach a decision whether or not such an anomaly exists. As

[2] Readers desiring to look these up should consult the bibliographies of Krausse (the fullest to date), Schönebeck, Eisendrath, and Riesman.

a result of this positive method of diagnosis many cases which would otherwise have escaped observation have been definitely proved to be genuine.

AGE. The age at which cervical ribs have been discovered varies from the sixth month of intrauterine life (Rosenmüller, Pilling) to old age. The age when the cervical rib produces symptoms, however, is far different. (*Vide infra.*) Symptoms rarely manifest themselves until adolescence. In other cases they do not arise until much later, though the patient has borne the rib since birth. The reason for this late onset of symptoms will be discussed later.

SEX. Why there should be such a disparity between the two sexes it is impossible to say, but it is at least curious to note that it is much more frequently met with in the female than in the male sex.[3] Among the 42 patients operated on, which I have collected, there were 31 females and only 11 males.

SIDE. Naturally one would expect the anomaly to be nearly, if not quite, equally frequent upon the two sides. As a matter of fact, we find that up to the time when Pilling collected his 139 cases (1894) it was believed to be bilateral in only about two-thirds of the cases. In all probability this does not represent the real percentage, because the smaller rib from its non-production of symptoms and difficulty of discovery has often been overlooked. The *x*-rays have demonstrated the far greater frequency of their bilateral existence. Thus, Schönebeck, in 1905, states that of eighteen skiagraphs, fourteen showed bilateral and only four a unilateral anomaly. In none of the fourteen was the rib equally developed upon both sides. Usually only the larger rib produces any symptoms. In fact, so far as I know, there are but two cases in which symptoms were developed on both sides (Rutkowski and Schönebeck).

In two cases there were two ribs on one side. Struthers records a case of rudimentary bilateral cervical ribs on both the sixth and seventh cervical vertebræ in the cadaver of a boy, aged four years, and Ehrich records another remarkable and, indeed, unique case, operated on by Karg, in which there were two cervical ribs attached to the sixth and seventh vertebræ. The subclavian artery passed *between* the two ribs in so narrow a space that full inspiration entirely obliterated the radial pulse. Stifler, in 1896, reported a case in which he believed the rib arose from the sixth cervical, but in the absence both of operation and a skiagraph, it is permissible to doubt. Beck believes that in his case there was a rudimentary

[3] Drs. Thomas and Cushing (Johns Hopkins Hosp. Bull., November, 1903, xvi) call attention to an interesting passage in Sir Thomas Browne's Pseudodoxia Epidemica or Commentaries on Vulgar Errors, London, 1650, 292, on the supposed difference between the female and the male skeleton as to supernumerary ribs, which caused a very heated discussion based on the Biblical story of the creation of Eve. However, this, like Eve, is a "side issue."

rib arising from the sixth as well as from the seventh vertebra. In Hauswirth's and Williams' cases, the rib was erroneously reported as arising above the seventh vertebra.[4]

With these few exceptions, the rib has always arisen from the seventh cervical vertebra.

Were this anomaly entirely an anatomical one, it would possess but little interest to the surgeon other than in operations on the subclavian artery or the brachial plexus. As in the cases of cervical rib, the subclavian artery lies much higher in the neck than usual, it lessens the difficulties of reaching the artery, but might mislead the surgeon were he not aware of the anomaly. Stanley Boyd mentions one case in which it was an advantage, as compression of the artery for aneurysm was greatly facilitated by the greater accessibility of the artery. But the cases in which symptoms arise may prove exceedingly serious and become of importance to the surgeon as well as to the neurologist, internist, and pathologist. The pain and disturbances of sensation which occur, the serious wasting of the muscles of the arm, the dimjnished if not total loss of usefulness of the arm, the partial or total obliteration of the pulse, the occasional gangrene of the fingers, and the occasional occurrence of aneurysm all make the lesion a matter of great surgical importance.

Anatomy. A cervical rib is only an abnormal development of a normal portion of the vertebra. We are apt to forget that in the cervical, the lumbar, and even the sacral region there exists a representation of that which in the dorsal region is fully developed into a normal rib.

In the accompanying diagrams (Fig. 7), from Morris' *Anatomy*, one can see that while the "costal process" is fully developed into a true rib only in the thoracic region, potential ribs exist in all the other three regions of the spine in a rudimentary form.

It is interesting to observe that the most frequent site for the extra rib is from the lowest or seventh cervical vertebra, that is, the point of transition from the last cervical to the first dorsal vertebra, very rarely from the sixth, and only in one case (Völcker) above that. Occasionally also supernumerary ribs are developed in the lumbar region adjacent to the last dorsal rib.

The development of the cervical rib may vary simply from a slight

[4] I have not included in my table of cases of cervical rib which have been operated on the case of Czerny and reported by Völcker, as the lipoma was the chief lesion and the rib was rudimentary and incidental. This very remarkable and unique case was one of fatty tumor of the neck, in a girl of fourteen. The tumor weighed a kilogram, was chiefly a deep lipoma, with areas of calcification and ossification. The pedicle of the tumor was a rudimentary rib connected with the transverse process of the fifth cervical vertebra. Völcker calls attention to the fact that lipomas frequently take their origin from congenital vices of development. He believes that in this case in all probability the tumor began in intrauterine life. This is the only case reported in the literature of a deep lipoma of the neck connected with the vertebral column and the only case of a rib arising above the sixth vertebra. There was no additional rib from the sixth and seventh vertebræ.

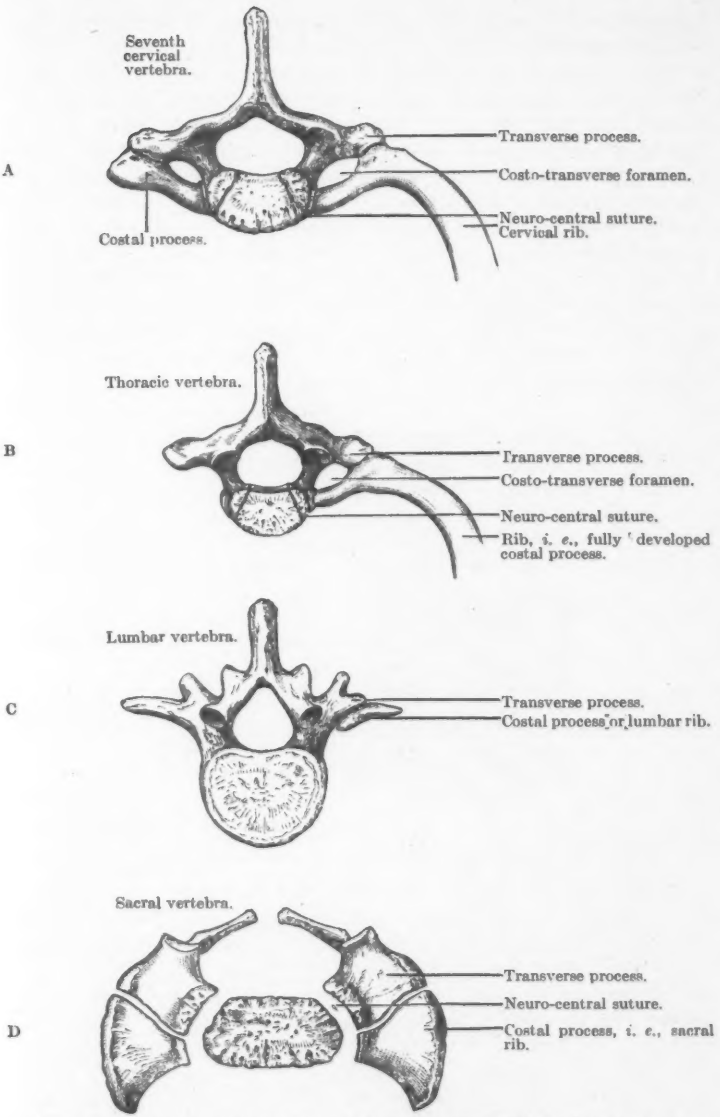


FIG. 7.—Note in A, on the right side of the seventh cervical vertebra, the costal process which on the left side is represented as a cervical rib. This costal process, or potential rib, exists in all the cervical vertebræ. In B, a thoracic vertebra, the fully developed costal process is a normal rib. In C a lumbar, and D a sacral vertebra, the costal process, *i. e.*, rib, exists in an undeveloped form. (Morris' Anatomy.)

exaggeration of the costal process of the seventh cervical all the way to a complete cervical rib attached to the sternum. Imperfect ribs are much more common than completely formed ribs. The best classification is that of Gruber into four degrees: First degree, a very slight increase of the costal process not reaching beyond the true transverse process. Second, a rib protruding beyond the transverse process to a moderate extent and ending either free in the tissues or attached in some way to the first thoracic rib. Third, a still further degree of development in which the cervical rib extends for a considerable distance toward or even to the cartilage of the first thoracic rib, possesses a complete body, and is united directly or by means of a ligament with the cartilage of the first rib. Fourth, a complete cervical rib uniting at the anterior extremity with the cartilage of the first rib through which it reaches the manubrium (Figs. 6 and 14.)

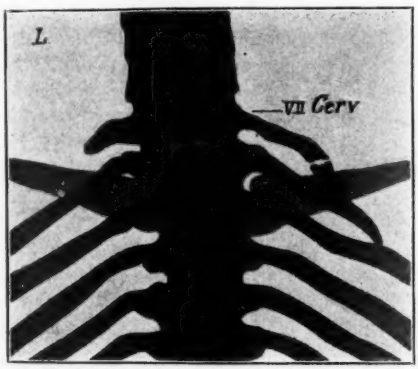


FIG. 8.—Note the very rudimentary rib on the left side; the larger one on the right side; the exostosis from the first dorsal rib with which the cervical rib articulates by a joint (Meyerowitz's Case 2.)

Dr. Lewellys F. Barker (an interested observer), in a private letter, states: "When I was in Europe, in 1904, I visited several anatomical museums and looked over the collections of cervical ribs. The best collection I saw was in Prague. The ribs showed the most remarkable diversity. Sometimes a cervical rib articulates behind with the body of the vertebra, sometimes with the intervertebral disk; in front it sometimes articulates with the first rib, sometimes with the sternum. Not infrequently there is extensive bony union between the cervical and the first rib. The length varies greatly. I saw very short nodules and all gradations between these and ribs running all the way to the sternum."

This is the fullest statement I have seen as to the variation in the vertebral attachment of the rib, except the important paper by

Drehmann. (*Vide infra* under Scoliosis.) It is to be noted that the vertebral attachment is sometimes by means of a complete joint, so that the cervical rib, like the dorsal ribs, is movable. In other cases there is no articulation; in this case the rib is immovable. Of course, if the anterior attachment of the rib is by a bony connection with the first rib, this also will render the tumor in the neck immovable. In several cases a joint has been noticed some distance from the first rib, in which case the specimen might be described as a cervical rib articulating with a longer or shorter exostosis from the first rib (Fig. 8). Not uncommonly this projection from the first rib, which, so to speak, rises up to a greater or less extent to meet the rib,

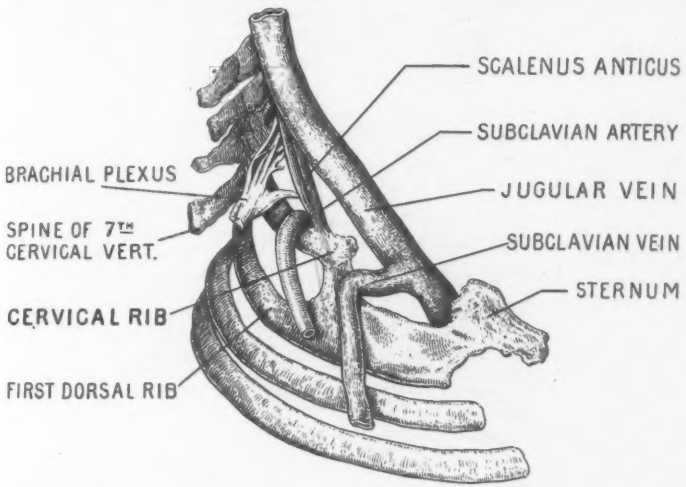


FIG. 9.—Rib and soft parts in the case of Weissenstein. Note the angle of the cervical rib, the sharp bend of the subclavian artery behind the scalenus anticus, and the position of the vein and the plexus.

is apt to be thickened at the point of junction, and produces a tumor consisting of two portions nearly at right angles to each other (Figs. 9 and 10; *cf.* Weissenstein, Ehrich (Madelung), de Quervain, Ranzi, Adams, Aron, Tilmann, and Borchardt). Commonly in the living subject the rib and the artery can only be traced to the level of the clavicle. Behind this they disappear and the anterior attachment of the rib can only be discovered by operation and sometimes not even then.

When cervical ribs are developed on both sides not only is one almost always more highly developed than the other, but one is apt to be at a higher level than the other (Fig. 11). The symptoms then arise on the side of the larger and the more highly placed rib.

The most important relations of a cervical rib are to the artery, the vein, the brachial plexus, the muscles, and the pleura.

FIG. 10.—Sketch of the rib in the case of Ehrich-Madelung, showing the angular shape of the rib, its articulations, and the knob (1) at the angle.

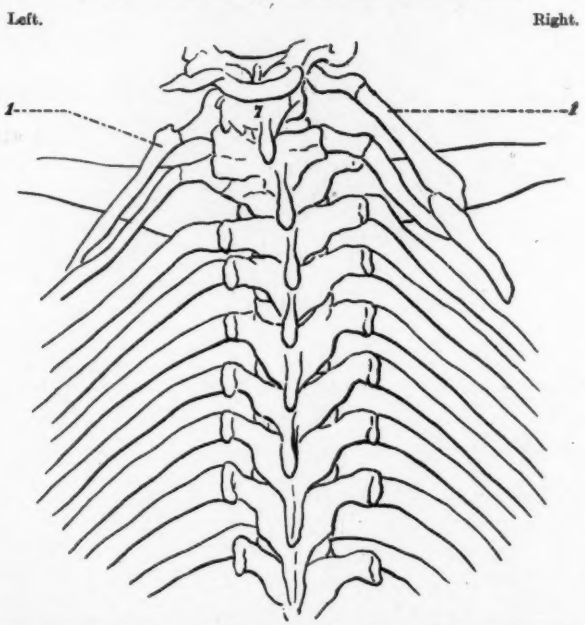


FIG. 11.—1, 1, cervical ribs. 7. Seventh cervical vertebra. Note how much higher the right cervical rib is than the left. Symptoms existed only on the right side. (Gordon, Brit. Med. Jour., June 8, 1901, 1395.)

The Artery. If the cervical rib is short or of only moderate development the plexus and the vessels do not pass over the rib,

but in front of its anterior end. The rule promulgated by Halbertsma (that when the length of the rib is under 5.1 cm. the artery passes in front of and not over it, but when the length is 5.6 cm. or more the artery passes over it) does not literally hold good, but within certain limits it gives a very fair idea of what generally occurs. Gruber, Aron, and Brodier have reported cases in which the rib was 5.6, 5.75, and even 7 cm. long, yet the artery did not pass over the rib. The artery never runs under the cervical rib. When the rib is of considerable length so that the artery and nerves pass over it, the chest cavity is lengthened by the addition of this rib; hence, the

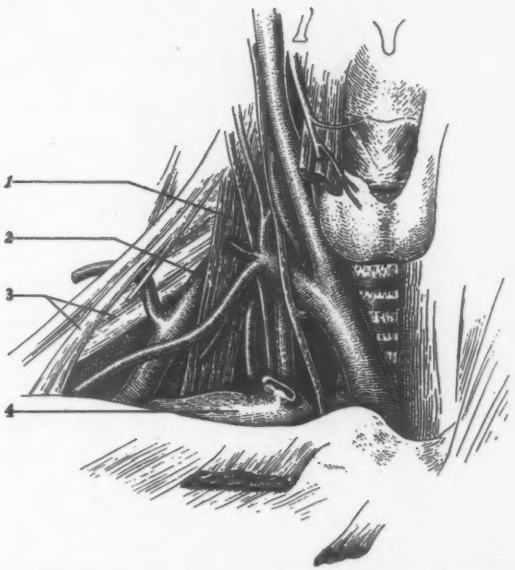


FIG. 12.—Showing that the subclavian artery may rise abnormally high in the neck, even when there is no cervical rib. Note also the position of the vein (Quain). 1. Scalenus anticus. 2. Subclavian artery. 3. Brachial plexus. 4. Subclavian vein.

artery is no longer than normal, rises much higher in the neck than normal, and after it crosses the extra rib, passes downward at a much more acute angle than usual. Ordinarily in order to compress the subclavian artery it is necessary to insert the thumb or finger well behind and beneath the clavicle, but as will be observed by looking at Fig. 1, in my own case, in which I outlined the length, diameter, and direction of the subclavian, it will be seen how far above the clavicle the artery passes and how oblique is its course. This photograph emphasizes the accessibility of the artery for compression in cases of aneurysm.

But it must be remembered that even when there is no cervical

rib the subclavian artery may pass high up in the neck. Thus, in the cases of "C. L." and "C. F. M." (*vide infra*) the artery rose 3.5 cm. above the clavicle. Quain (*Anatomy of the Arteries*, Plate XX, Fig. 3) also gives a case (Fig. 12) in which the same high position of the artery was shown by actual dissection, yet there was no cervical rib present.

The Vein. As a rule this is at a considerable distance in front of and below the artery. This is well shown in Fig. 12, and also in Fig. 13, from one of Broadbent's cases. This position of the vein,

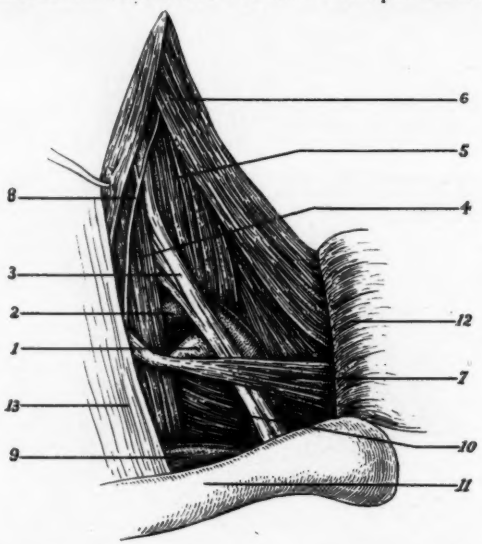


FIG. 13.—Showing especially the relation of the vein. 1. Cervical rib. 2. Subclavian artery. 3. Brachial plexus. 4. Scalenus anticus. 5. Scalenus medius. 6. Levator anguli scapuli. 7. Omohyoid. 8. Phrenic nerve. 9. Subclavian vein. (Broadbent, Brit. Med. Jour., May 5, 1906.)

and, as insisted upon by Murphy, its not being compressed between the cervical rib and the scalenus anticus, since it lies in front of this muscle, account for the absence of œdema in the arm in nearly all cases.

The Brachial Plexus. As the brachial plexus lies above and to the outside of the subclavian artery, whenever the artery passes over the rib, the nerves must also pass over the rib.[5]

[5] In Murphy's papers his artist has made two errors in the figures. An aneurysm is represented in one figure on the right side, and in another on the left side. In a personal letter Dr. Murphy states that the enlarged artery was on the left side, but that there was no aneurysm. The other error is more important. In Fig. 5 of the earlier paper and Fig. 3 of the later, the artist has represented the cross-section of the rib as a vertical instead of a horizontal oval, the artery to its outside instead of above it and the plexus below the artery and on the inside of the scalenus anticus, whereas the plexus really lies to the outside of and above the artery and wholly external to the scalenus muscle.

It is very important to determine the relation of these structures to the rib during operation, so that without injuring them we may gain easy access to the bone and remove it. Commonly the plexus is best displaced upward and outward, the artery downward and inward. Rarely will the vein require any attention, as it is not in the way. Indeed, often it is not even seen.

The Muscles. When the rib is developed to any considerable extent there is present an intercostal muscle, usually the external only. The scalenus anticus is often inserted into the anterior extremity of the cervical rib. *This is a clear evidence of the con-*

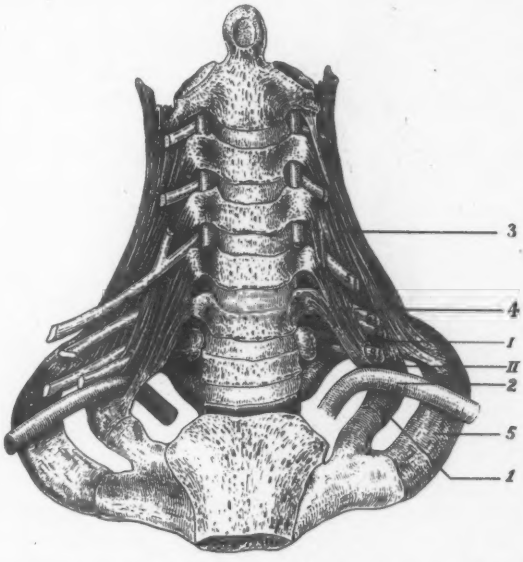


FIG. 14.—Showing division of the scalenus anticus into bundles by the artery and the nerves on both sides (Pilling). 1. Cervical rib. 2. Subclavian artery, which here shows in *front* of the scalenus anticus instead of behind it. 3. Scalenus medius. 4. Scalenus anticus, divided by the artery and the nerves into bundles. 5. First dorsal rib. I and II. Two bundles of the scalenus anticus on the left side; on the right side it is divided into three bundles. The artery could be compressed by the scalenus anticus on the right side, but not on the left. The roots of the brachial plexus are numbered 5, 6, 7, and 8.

genital origin of the anomaly. The medius and posticus may either escape insertion into the cervical rib or be inserted into this rib alone, or they may be inserted into the cervical and the first and second dorsal ribs. Occasionally (Fig. 14) the artery and nerve penetrate through the scalenus medius, dividing it into separate fasciculi. The importance of the muscular relation of the artery will be seen later.

The Pleura. The pleura rises much higher in the neck in cases of cervical rib than in the normal neck (Fig. 15). Its arched dome is often so closely adherent to the rib that it is very difficult and sometimes impossible to separate them without tearing the pleura. In other cases, as in my own, it is so easily detached that it may not even be seen. Its proximity must always be borne in mind and great caution exercised when dissecting the rib on its under surface.

SYMPTOMS. The symptoms may be grouped under four headings: (I) Local symptoms in the neck; (II) the nervous symptoms; (III) the vascular symptoms; and (IV) the muscular symptoms.

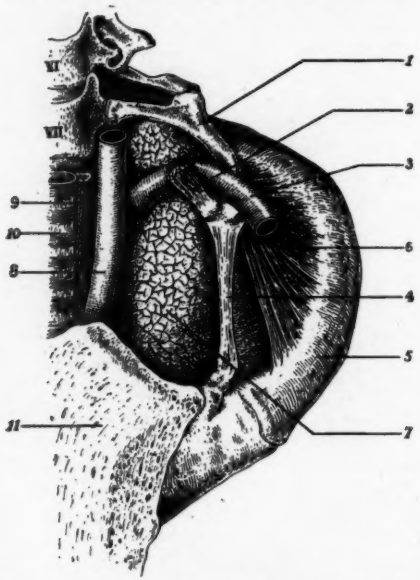


FIG. 15.—Showing a rudimentary rib (1) with its knobbed end, to which is attached the scalenus anticus (2). The rib is prolonged to the sternum by a ligamentous cord (4). Note *the relation of the pleura and lung* (7) *to the cervical rib.* 3. Subclavian artery. 5. First dorsal rib. 6. Intercostal muscle between the cervical and the first dorsal rib. 8. Left carotid artery. 9. Œsophagus. 10. Trachea. 11. Sternum. (Luschka.)

I. *Local Symptoms.* There is usually a tumor in the neck. This may be either palpable, or visible, and frequently is perceptible to touch and sight. The site of the tumor is usually about one to two fingers' breadth above the middle of the clavicle. It is usually more or less rounded, hard, more frequently immovable, but sometimes, when there is an articulation at each end, slightly movable. It can be traced back toward or even to the seventh cervical vertebra. In addition to this, above the tumor, and, therefore, relatively high up in the neck and running obliquely from above downward and

outward, there is a visible and palpable pulsation. A high and oblique pulsating vessel, if observed, should always arouse the suspicion of a cervical rib. The cause of this pulsation is the displaced subclavian artery. There may be a bruit, which, however, is not often propagated; rarely will there be a thrill. The pulsation is sometimes expansile, but more commonly it is not. Just above and to the outside of this pulsating vessel there is tenderness, and in very thin patients the seat of this tenderness, namely, the brachial plexus, is palpable. On the other hand, palpation is, in my opinion, a very misleading, and by no means reliable, method of examination. Dr. Patrick, of Chicago, in communicating to me the history of his first case (the first one, I believe, diagnosticated and operated on in Chicago) has also made the same observation. The diagnosis reached by palpation should always be confirmed, or, as is sometimes the case, refuted by a good skiagraph. If the rib is very small, it may easily escape attention even on a careful physical examination.

As illustrations of the impossibility of absolutely determining by palpation the existence of a cervical rib, I mention the following cases seen by myself:

Supposed Cervical Rib, there being no Pulse up to and including the Axillary Artery on both sides and later none in the Subclavian. A skiagraph showed no such Rib.

C. F. L., aged twenty-three years, was first seen December 9, 1905, with Dr. T. D. Taggart.

Dr. Taggart recently had percussed her chest and neck and then accidentally discovered, as he believed, that she had bilateral cervical ribs. Up to that time she had no knowledge that there was any trouble in her neck. She has had absolutely no symptoms either of pain or discomfort.

On examination I found what I too thought was a cervical rib on both sides, which could be traced back to the spinal column. The subclavian artery on the right side was 3.5 cm. and on the left 3 cm. above the clavicle. It pulsated normally. Below the subclavian, in the axilla, arm, and forearm, no pulse whatever could be discovered on either side. The resonance of the lung in the neck extended up to the level of the cervical rib.

January 9, 1906. Examination of an *x*-ray picture shows no cervical rib on either side (Fig. 16). Re-examination of the patient showed a hard supraclavicular tumor on the left side with a smaller similar one upon the right. This probably is the first dorsal rib more highly placed than usual. I could not now detect, on either side, pulsation either in the subclavian itself or in any artery below that in either arm, yet the circulation was not affected, the skin was not blue, the white spots caused by pressure disappeared as quickly as usual, and in every way the arm seemed to be normal.

October 26, 1906. The same conditions as noticed in January still exist.

Partially Developed First Dorsal Rib Mistaken for a Cervical Rib. A Bruit, but no Perceptible Thrill in the Subclavian Artery.

C. F. M., aged twenty-one years, telegraph operator, was first seen January 30, 1906. About eight years ago he noticed an enlargement on the left side of the base of the neck. No other symptoms appeared until four months ago. Since then he has had a sensation of numbness in the left arm. It sometimes extends downward and involves the flexor surface of the forearm. During the past four months he thinks that the mass he observed has increased in size.

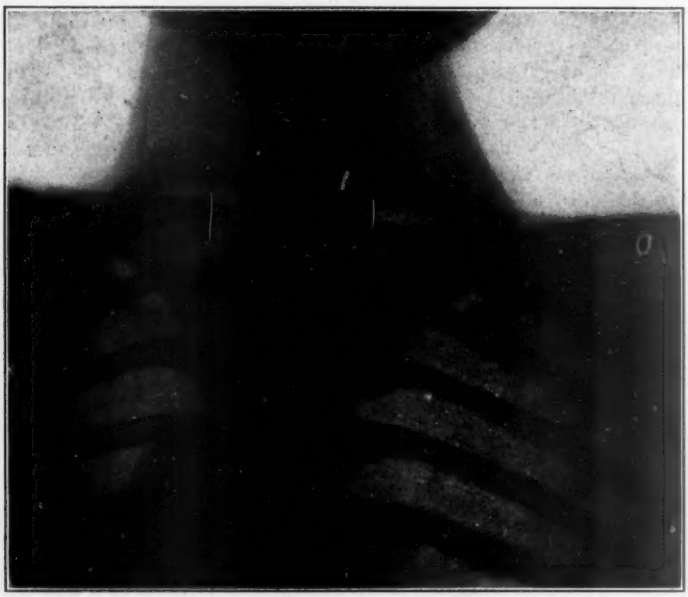


FIG. 16.—Case of C. F. L. Supposed cervical rib. Skiagraph shows none, yet there is a hard tumor in the neck and no pulse in either arm from and including the subclavian. (Keen.)

On examination the left side shows a fulness and the subclavian artery can be seen pulsating directly under the skin. Careful palpation shows that the subclavian artery appears in the neck at a point 3.5 cm. above the upper border of the clavicle and runs downward and outward, disappearing behind the clavicle. Palpation also shows behind and below the artery a hard, immovable mass which I believed to be a cervical rib. It could be traced backward to the spinal column and forward to the clavicle, behind which it was lost. At this time I did not make a careful examination of the first rib at the normal point for its attachment to the sternum. No

thrill could be observed in the artery, but there was a distinct bruit observed by the stethoscope. Evidently the artery passed over the first rib. Its diameter also seemed to be increased. The pulsation in the two arms was normal. The right side of the neck showed no such prominent hard mass, no pulsation was visible, no bruit, and the subclavian artery ran behind the clavicle at its usual level.

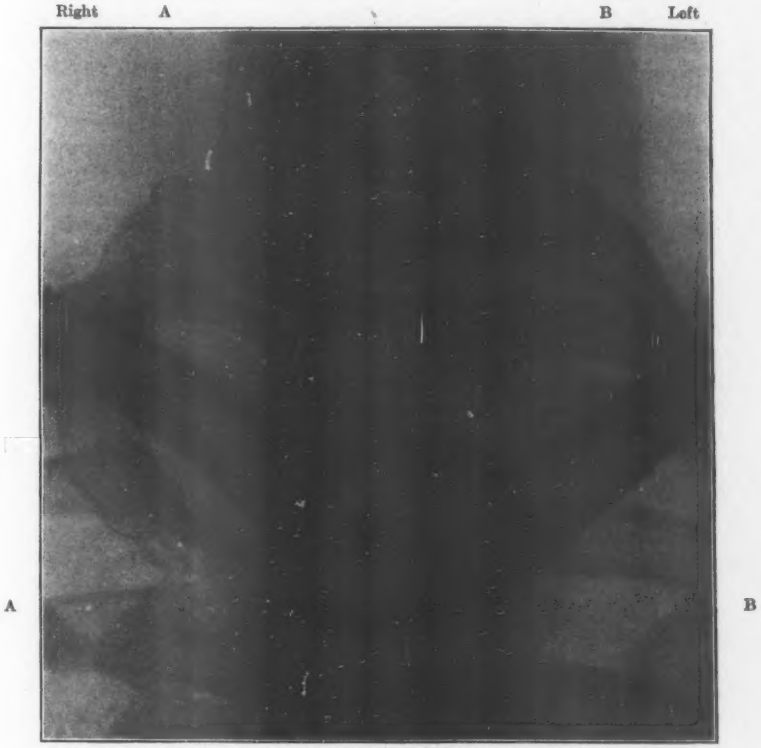


FIG. 17.—Partially developed first dorsal rib on the left side mistaken for a cervical rib. (See text.) (Keen.)

Dr. J. C. Da Costa, Jr.. kindly examined his blood pressure and found a systolic blood pressure in the normal position of the left arm, of 132 mm. With the patient sitting upright and the arm raised above his head it was 125 mm.

I directed that a skiagraph should be taken. On examination a very unusual anomaly of the first rib was observed.

The supposition that the patient had a cervical rib was proved by the skiagraph to be incorrect. On the right side (Fig. 17) the first rib is very clearly seen and at the point where the two lines A A would

cross, the cartilage of the first rib is seen to be mottled, as though it were undergoing ossification, although the patient was only twenty-one years of age. On the left side is a still more peculiar condition. The first rib, instead of curving forward from the spine, as does the right, changes its direction at its articulation with the transverse process and thence runs almost in a straight line downward and outward. The tip of it is lost at the point where the first rib and the clavicle cross each other. From that point to the sternum there is no rib, but on the sternum, at the point where the two lines B B would meet, is a conical projection from the sternum just below the end of the clavicle. This represents the point at which the first rib would have articulated had it reached the sternum.

When I first examined the patient I felt certain that he had a cervical rib on each side and I was only undeceived by the skiagraph. Palpation seemed clearly to indicate a cervical rib.

II. *Nervous Symptoms.* The nervous symptoms are considerably more frequent than the vascular. About two-thirds of the patients complain of pain and other nervous symptoms, whereas only about one-half suffer from vascular troubles. Commonly the very first symptom is pain, shooting or neuralgic in character, starting usually in the neck and radiating down the arm sometimes as far as the elbow, sometimes all the way to the hand; more commonly on the ulnar than the radial side of the forearm. Sometimes the pain radiates to the head; sometimes to the chest. It often begins in one or more fingers and gradually spreads to the other fingers and then extends up the arm. Muscular exertion, especially hard work, is likely to increase the pain, or sometimes is thought to have caused it. It is sometimes worse in winter than in summer.

Again, the involvement of the nerves is shown by diminished or perverted sensation. The cases in which the sensory phenomena have been the most carefully observed, are that of Dr. Lewellys F. Barker in his own person, and by Bernhard. In one of Dr. Patrick's cases (No. 32), he has kindly allowed me to copy his drawings, showing the disturbance of sensation (Figs. 22 to 25), as have also Mr. Sargent and Dr. Buzzard (Fig. 27). In Patrick's case (No. 32) the anesthesia was so marked that an accidental burn of the forearm was felt but little.

The paresthesia is frequently described as the sensation of pins and needles, formication, tingling, numbness, or "going to sleep." The area usually corresponds with the portion of the arm supplied by the lower cords of the brachial plexus. Moreover, there is either diminution, or, in some cases, entire absence of electrical reaction and in advanced cases the reaction of degeneration is shown. In one case (No. 5) there seems to have been a distinct neuritis, so that when the elbow had been extended to 150° it was impossible to extend it farther on account of the pain.

In Hauswirth's case, handling of the extremity produced such

pain that it had to be conducted with the greatest gentleness or even abandoned.

The sympathetic nerve apparently has been involved in four cases. Müller's case showed typical paralysis of the right cervical sympathetic. In Hirsch's case there was profuse sweating and coldness on one side, and dryness of the skin on the other. Gordon attributes the rapidity of the pulse in his case to irritation of the sympathetic. In Schönebeck's case (No. 61 in his series) a patient with bilateral symptoms, the left pupil as well as the left palpebral fissure was larger than the right, and there was facial asymmetry. But in this case the cervical rib was associated with syringomyelia.

Hoarseness. In a few cases (Nos. 2, 6, 16, and 19) there has been hoarseness. This is probably due to some actual affection of the throat and not to involvement of the recurrent laryngeal, which is far removed from the possibility of pressure. In only one case, Borchardt (No. 19), has a laryngeal examination been made. This showed that the right vocal chord was paralyzed. This patient suffered also from syringomyelia.

III. *Vascular Symptoms.* I have already alluded to the marked pulsation in the neck. In Ehrich's case (No. 4), on the contrary, pulsation even in the subclavian was entirely absent and the artery felt like a hard cord, owing presumably to a thrombus in the vessel. In very many cases this is probably due to distal blocking of the vessel. On the other hand, aneurysm has been asserted to exist in a number of cases. (*Vide infra.*)

In a considerable number of patients the pulse at the wrist has been entirely absent and not uncommonly it has been absent also in the forearm, the arm, and the axilla. This, doubtless, is due to a thrombus. As a result of the ischemia the hand and often the arm become cold and blue, or more frequently blanched, sometimes even suggesting possible Raynaud's disease. The blood returns very slowly to the part after brief pressure on the tissues. Generally, even after operation has removed the obstruction to the circulation, the pulse fails to return and the obstruction is permanent. In Babcock's case, and partially in my own, the pulse returned after operation, but this is very rare. Yet the collateral circulation usually is partly established so that gangrene (*vide infra*) is unusual. The thrombus is apt to extend somewhat slowly upward to the subclavian, and even that vessel may be involved. I know of no case in which it has progressed beyond this point. In the case of C. L. F. (*vide supra*) it finally involved the subclavian on both sides, but without apparent injury to the vitality of the arms. In this case there was no cervical rib.

Gangrene. In the cases of Babcock, Gordon, and my own in my table, and in those of Cooper, Hodgson, and Gould, owing to the arrest of the circulation, gangrene of the tips of the fingers has followed. Grisson's case was on the verge of gangrene. But

in other cases, even when the pulse has been obliterated as high as the brachial and even the subclavian, the re-established circulation has prevented this misfortune. The gangrene has never extended in any case that I have found beyond the first phalanx, and usually is limited to the tips. After operation, or without it, the parts gradually mummify, drop off, and the resulting ulcer heals. It is worthy of note, that of these seven cases two of the six, in which the age is stated, occurred in patients nineteen and twenty-two years of age; the others ranged from thirty-two to sixty-three years.

The effect on the pulse of varying the posture of the arm has been quite marked in a number of cases. On raising the arm the pulse returned, and in addition to this, apparently from the relief of pressure, the pain would diminish. Sometimes a deep inspiration by raising the rib in the neck would produce marked influence upon the volume of the pulse, and in one unique case (No. 4), at the height of inspiration, the pulse disappeared entirely.

Œdema is exceedingly rare. Like Murphy, who says "that in looking over the clinical records of these cases, he was struck by the absence of œdema as a symptom," I, too, have been much impressed with its absence. Yet there are four cases in which there seems to have been a possible partial involvement of the vein. In Gordon's case, two months after the onset of the symptoms, there was swelling of the hand, but no pitting on pressure. The artery was obliterated from the middle of the arm down and gangrene followed. In Hauswirth's case, he expressly states that "the hand and forearm were swollen, blue, and cold;" and Berg, at the operation on his case, found "the veins of the suprascapular and transverse cervical systems considerably enlarged and required double deligation." In the case of de Quervain, before he saw his patient, a soldier, the physician calling for him noted that there was some swelling and redness of the skin. When de Quervain saw him about four months later, he said that on the affected side "the veins of the back of the hand were fuller than upon the other side." In Thorburn's patient, the hand was cold, and there was a very slight œdema "which may have been due to pressure upon the subclavian vein."

In none of these cases is pressure upon the vein more than suspected, and I think it extremely doubtful whether the swelling or the slight œdema had any relation to the subclavian vein.

Murphy explains this absence of œdema "by the fact that the scalenus anticus is attached to the first rib and lies between the artery and vein so that the latter, situated in front of the muscle, has nothing to hold it firm for counterpressure." When the scalenus anticus is attached to the cervical rib, the vein lies in front of the muscle and the artery behind it.

Aneurysm. In ten cases (Poland, Adams, Stiffler, Murphy, Ehrich (Karg), Fischer, Braun, Pancoast, Grisson, and Conner), and a

few other more doubtful cases, the symptoms suggested an aneurysm. None was found, at operation, in Pancoast's case, and only flattening of the artery in Murphy's. Conner says that the pulsation "suggested aneurysm." There is no question that at operation the artery has been found enlarged by some observers (Ehrich, Murphy, Keen) (Fig. 4), and at the necropsy in Adams' case a cylindrical aneurysm was actually found extending from the outer border of the scalenus anticus to the brachial.

But the curious fact is that in these cases, as in my own and others, the dilatation of the vessel was external or *distal* to the point where the artery passed over the cervical rib and distal to the point where it passed behind the scalenus anticus muscle. It is difficult to account for the dilatation distal to the point of pressure or constriction. Possibly it may be due to resistance caused by the still more distal blocking of the artery.

Murphy has made a special point that in the inspiratory movements of the thorax the artery is caught between the rib and the scalenus anticus, and he thus explains the aneurysm.

Even granting, as is probable, that the artery is pinched between the muscle and the bone at this point, this obstacle to the circulation should produce a dilatation *proximal* to the point of constriction and not distal, just as in the case of obstruction of the intestines from a band the bowel is distended proximal to the band and shrunken on the farther side. The observation in my own case was very carefully made and I am absolutely positive of the small caliber up to the point at which the artery emerged from behind the scalenus anticus, and its caliber was nearly doubled from there down to the level of the clavicle. In Murphy's case (No. 31) the artist has represented what, at first sight, seems to be an aneurysm of large size distal to the scalenus. Dr. Murphy's text describing the case shows that there was no aneurysm, but that the artery "was somewhat enlarged" and in five weeks "had contracted to its usual size." The illustration, Dr. Murphy informs me, was intended to show only flattening of the artery. In Poland's and Fischer's cases compression produced early consolidation in the artery and resulted in cure and a return to work.

Usually the pulsation is visible as well as palpable and is very marked. It is occasionally noted that it was "expansile." Bruit or thrill, one or both, are often present, the latter less frequently than the former. The bruit, however, is not propagated. Neither the thrill nor the bruit seem usually to be of the true aneurysmal character. Moreover, the "aneurysm" rarely increases in size or symptoms. Under pressure, or more often without any treatment, it either remains as before, or lessens, and may disappear. In no case has the vessel been ligated; a very wise abstinence.

Another curious case is that of Ehrich (No. 4), in which though at operation the walls of the artery are described as apparently sound

the aneurysm developed *after* operation. This may have been due to the loss of support of the bone and other tissues around the artery and to the injury to the walls of the artery by the constant respiratory compression between the two ribs.

On the whole, the evidence of true aneurysm in most of the cases in which it has been reported, are, to my mind, by no means always convincing. Usually the diagnosis has been based on the strong pulsation, sometimes with bruit and thrill. In a few cases, as in my own, the artery has been found, at operation, moderately enlarged, or in one case (Murphy's) flattened. In several cases operation has, therefore, disproved the presence of the supposed aneurysm. The postmortem in Adams' case disclosed a cylindrical aneurysm. Bearing upon the history of pressure or tension of the artery as it crosses the cervical rib, it is significant in Fischer's (Braun's) case that when the arm hung *down* (pressure or tension) bruit was present, and when it was held up (relief of pressure) the bruit disappeared.

That these aneurysms should have undergone spontaneous cure without treatment, other than bandaging and pressure, or removal of the rib, is certainly sufficient to make one suspicious of there ever having been a true aneurysm, except in a very few cases.

In a letter to Prof. Turner, Paget very suggestively says: "In each case the imitation of aneurysm was close enough to deceive an unwary surgeon; but to one who examines closely, and has in his mind what the case may be, the mistake seems scarcely possible, so long as the artery is healthy."

Thrombosis. Allied to the question of aneurysm is that of thrombosis. Here we are on much firmer ground; for that there is a constriction of the artery and an interference with the blood current which might be followed by coagulation there is no doubt. Thrombosis has been recorded by Hodgson, Cooper, Adams, Coote, Braun, (Fischer), Ehrich (Madelung), Gordon, Keen, Fischer, and Grisson.

The extent of the thrombosis varies somewhat, but may involve the arteries of the forearm, not uncommonly of the arm, the axillary, and even the subclavian. Occasionally the progress of the thrombosis has been followed almost day by day, from wrist to axilla. Pulsation in the artery is then, of course, absent and the artery itself is felt as a hard solid cord. After removal of the rib, it is rare for the pulsation to return (Babcock, Keen). The collateral circulation, as would naturally be expected, is established after a time, but is often so imperfect that the skin is very cold and white or blue; and after pressure the color due to the restored circulation returns very slowly. Gangrene of the finger-tips has been considered.

IV. *Muscular Symptoms.* The muscles of the arm on the affected side usually undergo gradual wasting, so that the circumference of the arm and forearm will be from 1 cm. to 4 cm. less than the opposite one. This wasting is especially marked in the thenar and

hypothenar muscles, not uncommonly also in the interossei; often the muscles of the forearm are involved. Occasionally the loss of power extends to the muscles of the shoulder and the chest. Along with this there is markedly lessened usefulness of the arm and especially of the hand in the more delicate movements required in sewing, writing, etc. The arm becomes easily tired and the fingers stiff. If the work is at all severe it has to be given up. It will be noticed that the muscles as well as the sensory area involved point to the lower cords of the brachial plexus and not to the upper.

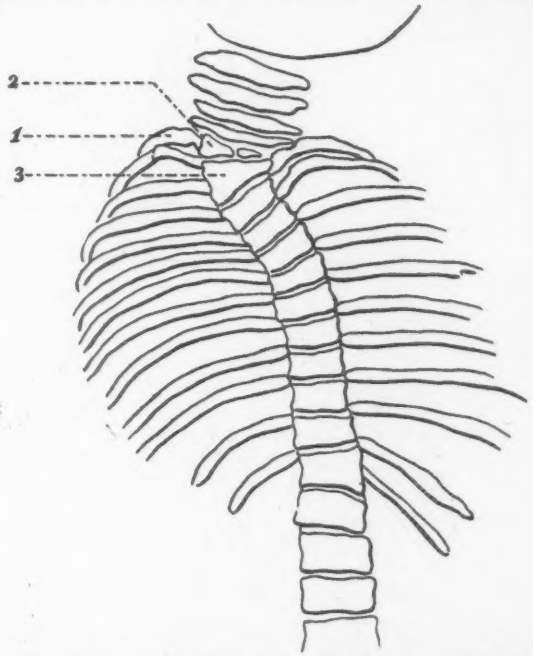


FIG. 18.—Scoliosis with cervical rib; child, aged eighteen months. Note 1, cervical rib attached to one portion of 2, the intercalated body of a cervical vertebra in two pieces. 3. Wedge-shaped body of the first dorsal vertebra bearing two ribs. (Drehmann, Fig. 2.)

Dysphagia. In the cases of Bernhardt, Ranzi, and Tilmann, dysphagia was also noticed. This, most likely, was hysterical, since there is no evidence of there being any direct pressure or interference with the function of the œsophagus. Yet this symptom was so severe in a case seen by Kiliani as to suggest even cancer of the œsophagus. Both he and Lilienthal agreed that it was due to muscular spasm.

Scoliosis. In Schönebeck's sixty-one collected cases (1905) scoliosis existed in twenty-two. In several of the cases operated

upon, scoliosis is also recorded. This, of course, is of special interest to the orthopedic surgeon. The convexity is usually toward the side of the cervical rib, or if a rib is developed on both sides, the convexity is toward the side of the larger rib. The deflection extends from about the fifth cervical to the fourth dorsal vertebra. It usually is attended also with a high scapula on the convex side.

In 1902, Garrè called attention to scoliosis in connection with cervical rib. Before this Drehmann had reported four such cases, but had not at that time the advantage of the investigation by the *x*-rays.

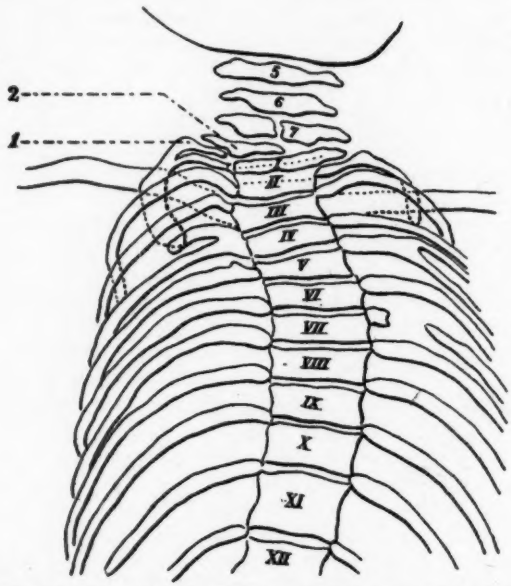


FIG. 19.—Scoliosis with cervical rib. Boy, aged twelve years. Note 7, the body of the seventh cervical vertebra in two pieces. Between it and I the first dorsal vertebra is 2, an intercalated fragmentary body of a vertebra carrying 1, a rudimentary cervical rib, which quickly fuses with the first dorsal rib. Note also several other abnormalities of the ribs on both sides. (Drehmann, Fig 6.)

In 1906, at the Congress of the German Orthopedic Association, Drehmann returned anew to this subject and presented the most important paper on this form of scoliosis which has yet appeared. Moreover, the article is illustrated with reproductions of skiagraphs of his cases, and what is most useful, outline sketches indicating what may be seen in the skiagraphs. It requires a little imagination, I confess, to identify all the parts of the outline drawings in the skiagraphs, but enough is seen to convince one that in all probability the sketches are faithful to what is seen in the originals, which, of

course, are very much clearer than the reproductions, excellent as they are.

In one child, aged eighteen months, with wryneck, but without rickets, the skiagraph showed (Fig. 18) a marked scoliosis in the cervicodorsal region. "On the convex side there is a fully developed cervical rib which stands in relation with a supernumerary vertebra. This vertebra is divided into two parts: a large wedge-shaped portion, which carries the rib, and a small rudiment on the

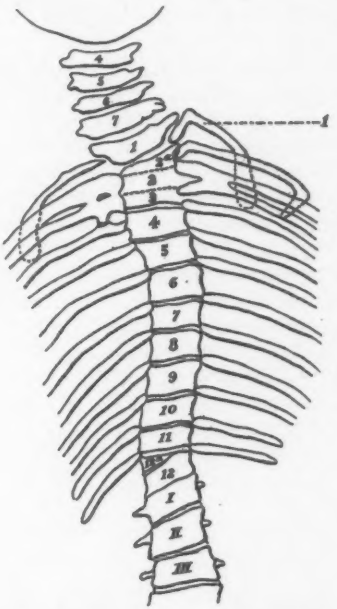


FIG. 20.—Scoliosis with cervical ribs. Girl, aged fourteen years. Between the bodies of the first and second dorsal vertebræ is a wedge-shaped supernumerary body, 2a, fused with the bodies of the second and third dorsal vertebræ. This rudiment carries a cervical rib, 1. Several other anomalies of the ribs and the vertebral bodies are to be seen. (Drehmann, Fig. 8.)

concave side. On the convex side of the scoliosis the first dorsal vertebra carries two ribs. It is made up of two parts; the upper piece corresponds to the normal vertebra, under which is placed also a wedge-shaped vertebra, which also carries a rib." It will be observed also that on the right side the twelfth vertebra carries two ribs.

In another case, a boy, aged twelve years, the skiagraph shows "A division of the seventh cervical vertebra, and between it and the first dorsal vertebra a wedge-shaped vertebral rudiment is inter-

calated, which on the convex side carries a cervical rib. This cervical rib unites with the first rib (Fig. 19). The first and second dorsal vertebræ cannot be differentiated. They seem to be blended with each other. The fourth rib on this side is also rudimentary. On the opposite side the fourth rib bifurcates, and it seems as if on both sides the fourth and fifth ribs are united. The seventh rib also shows a defect on the right side."

Another case (Fig. 20) shows several anomalies in the ribs and the vertebral bodies, as noted in the legend.

Several of his figures also show some remarkable deviations from the normal in the lumbar vertebræ, as well as in the cervicodorsal.

He calls attention to the fact that up to the present time congenital scoliosis has been held as an extreme rarity. He believes this to be an error and urges methodical examination by the *x*-rays.

The cases he describes are divided into two classes: the first group are those in which the supernumerary rib belongs to a corresponding rudimentary intercalated vertebra; the second group, those cases in which a true cervical rib exists, without any intercalated vertebral fragment.

As to treatment, he believes that extirpation of the supernumerary rib in these cases is entirely useless, since they ought not to produce any pressure symptoms on the plexus.

Cause of the Symptoms. Borchardt believes that only about 5 to 10 per cent. of the cases of a cervical rib are followed by any symptoms. Whether this is at all an accurate percentage is rather unimportant; it is certain that the vast majority of cases, in which this anomaly exists, have no symptoms whatever which can be attributed to the presence of the rib. There must be, therefore, something exceptional in the cases which show symptoms different from the majority. I am inclined to believe that in Laplace's case the symptoms were due to the severe trauma to the shoulder and not to the presence of the cervical rib.

Injury. In a certain number of cases there can be no question that injury, direct or indirect, is responsible for awakening the symptoms. Thus, in cases Nos. 2, 23, and 33 the patient had a fall. In Poland's case the drawing of a cork was attended with a feeling as if something had been torn loose in the neck. In Stiffler's case, lifting of the arm was attended with a feeling of a tear in the neck and was assigned as the cause of the resulting aneurysm. In three cases (Nos. 4, 7, and 15) pressure of the rifle at "shoulder arms" or the pressure of the straps of the knapsack were clearly the cause of the trouble, and Brewer's patient was a peddler. Other occupations, such as that of a seamstress, sewing base-balls, paring potatoes for two hours (Marburg), writing, piano playing, etc., seem to have had a definite influence.

In consequence of the protrusion of the end of the rib, there is more danger of injury than where the parts are normal. In

Williams', Borchardt's (No. 18), and Starr's cases, even so slight a constant but repeated injury as the pressure of the collar seems pretty clearly to have evoked the earliest symptoms.

Ill Health. It is to be noted that in a very considerable proportion of the patients ill health preceded the first symptom. Repeatedly, anemia, chlorosis, general ill health, or some debilitating disease is noted. This may have been a factor in arousing the trouble by the wasting of the fatty tissues in the neck itself besides its general predisposing influence. In Borchardt's case (No. 20) diphtheria seemed to be the cause of the trouble; possibly by the direct toxic effect.

Pressure, Constriction, and Sharp Bending of the Artery. Pressure and constriction of the artery may arise in two ways. I have already alluded to the view that Murphy has particularly advocated that there is marked compression of the artery in the angle between the rib and the scalenus anticus. That this is true I think there is no doubt. In Weissenstein's case, dissection shows excellently how this is brought about (Fig. 9; see also Fig. 4). Halbertsma and Luschka have advocated the view that the trouble is due to direct pressure of the rib on the artery, especially in inspiratory movements in which the cervical rib would lift the artery by muscular effort. At the rate of sixteen inspirations in the minute, an upward excursion of the rib occurs nearly 1000 times in an hour and about 23,000 times in a day. If continued day after day for years, even this slight upward pressure in lifting the artery might easily produce such an obstacle to the circulation and such a possible effect upon the arterial walls as to be followed by a diminution in the volume and force of the pulse and not uncommonly by thrombosis. Gruber believes that there can be no such tension of the artery from upward pressure, and Sue insists that if the cage of the chest is developed vertically to a greater extent than is normal the arteries would also develop *pari passu* in length. This view of co-ordinate development of the chest and the bloodvessels seems very plausible, especially in view of the fact that only a small percentage of cases, in which cervical rib exists, do show any symptoms. But to my mind, the argument that pressure and its results really exist in the cases with symptoms is valid for the following reasons:

1. As a matter of fact, at operation a sharp bend in the artery has been especially noted by Ranzi and was marked in my own case. In Borchardt's case (No. 18) traction on the hand downward was seen to cause complete compression of the artery between the scalenus and the rib, and in de Quervain's case, certain movements of the shoulder compressed the artery between the rib and the clavicle.

2. In a number of cases the moment that the rib has been removed the artery has sunk down into the soft tissues of the neck, showing the relief of tension, and the symptoms have quickly disappeared.

3. Murphy writes me that in his first case (No. 31) the artery was *flattened.*

4. In Kammerer's case, the pulse completely disappeared on deep inspiration and in others it was weakened.

5. It should also be pointed out that the argument has been applied only to the artery. The nervous symptoms, due to the lesion of the brachial plexus, are much more frequent than the circulatory symptoms. As to the nerves, the argument of Sue entirely fails, because the brachial plexus arises in the neck *above* the level of the cervical rib and the course of the plexus is from above downward and outward. Angulation cannot then be assigned as the cause, as in the case of the artery; but the upward pressure of a longer cage of the thorax certainly exists and this upward pressure is constantly repeated, as in the case of the artery at every inspiration. Coote, in the first case ever operated on, expressly

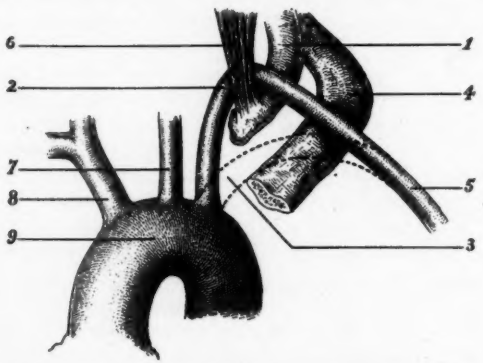


FIG. 21.—Scheme to show the changed course and the consequent angulation of the subclavian artery when it passes over a cervical rib. The dotted line (3) represents the normal gentle curve of the artery. 1. Cervical rib. 2. Subclavian artery passing over the cervical rib. Note its high position, its angulation, and the likelihood of pressure by the scalenus anticus 6. 4. First dorsal rib. 5. Axillary artery. 7. Left carotid. 8. Innominate. 9. Aortic arch.

states that "the nerves were *flattened* upon the upper surface of the rib." Warren notes that the brachial plexus "had been somewhat *stretched* by the arched position of the bone." Removal of the bone relaxed the plexus. In my own case the same phenomena were observed. In Thomas and Cushing's case direct "compression" of the lower cord of the plexus "by a dense fibrous band which passed from the tip of the rudimentary rib under the plexus to its point of attachment on the first thoracic rib" was found. This band represented the continuation forward of the imperfectly developed cervical rib.

6. Moreover, as in the case of the artery, the removal of the offend-

ing rib almost always has been followed by sinking downward of the plexus and relief of the nervous symptoms.

7. Again, the *lower cords* of the plexus are much more frequently involved than the upper. This is consonant with the theory that it is the upward pressure of the cervical rib lifting the lower, rather than the more distant upper cords which produces the lesion. Naturally, the upper cords would be the most likely to escape. The artery would not show this so well, since its walls are elastic and its contents fluid.

Angulation. The subclavian artery, arising either on the left side, directly from the aorta, or on the right side, from the innominate as it passes outward in a gentle curve to the axilla, rises normally into the neck a little above the upper border of the clavicle. In Fig. 21 the dotted line shows its normal course. In cases of cervical rib the artery usually rises in the neck from 3.5 to 5 cm. or more above the level of the clavicle and must bend acutely downward and outward to reach the axilla, as shown in Fig. 21. This shows the difference between the normal course of the subclavian artery and by contrast its course when it runs over a cervical rib. It shows also the *necessary* sharp bend or angulation in the artery when a cervical rib is present. See also Figs. 9, 12, 13, 14. and 15. In almost every case it is noted that the pulsation of the subclavian artery was felt or seen, or both, far above the level of the clavicle, instead of being just behind that bone or barely above its level. This sharp bend or angulation of the artery, in addition to tension or pressure, I believe to be of considerable influence in producing the vascular symptoms.

How can we Account for the late Appearance of the Symptoms? The age at which symptoms have been noticed in the 42 cases operated on was as follows: Under fifteen, 6, that is, at seven, nine, ten, twelve, thirteen, and fourteen years; fifteen to twenty, 15; twenty-one to thirty, 8; thirty-one to forty, 11; sixty-two, 1; not stated, 1.

It will be seen that in a large majority of the cases the symptoms do not arise until after fifteen years of age, and in some comparatively late in life. Murphy is disposed to ascribe the outbreak at puberty or later to the growth of the rib occurring chiefly between the cartilage of the anterior end and the bone. Naturally, with growth in size from childhood to adult life, all the bones grow in length, and a cervical rib would be no exception. It seems to me that in the cases in which the symptoms appear late in life, as in my own case at sixty-two years of age, and Rutkowski's at fifty-nine, and others not in my table about the same age, this is not due to any one but to a number of factors. For example, arteriosclerosis would have some influence as the arteries begin to lose their elasticity, and if they are subject to any unusual pressure between a cervical rib and the scalenus anticus or by the repeated lifting action of the rib, changes in the wall of the vessel would be likely

to occur which might easily lead to retardation and even to thrombosis. I have seen a case of senile gangrene of both feet, from calcareous arteries, at forty-five years. Moreover, as we get older, the muscles become more flabby and lose their tone, so that the shoulders sink to some extent. This would naturally increase the angulation of the artery where it passes over the cervical rib and also increase the pressure whether from the rib or from the scalenus anticus.

Again, if the rib itself is long, and especially if it reaches well forward on the first rib or even to the sternum, the space between the clavicle and the cervical rib would be much narrower than it would be in cases without a cervical rib. This may produce an increase of pressure, especially in any movements of the shoulders backward which might be involved in daily labor. In Schnitzler's case the anterior end of the abnormal rib approached so close to the clavicle that it acted as a fulcrum, so that when the shoulders were thrust backward the inner end of the clavicle was dislocated. Garrè also has called attention to bending of the clavicle at the junction of the middle and outer thirds by reason of similar pressure.

Babcock considers "that the symptoms result from the increased size or the greater fixity of the rib," and alludes to the fact that the ossification in the transverse process does not begin till puberty and is not complete till about twenty-five years. Moreover, in the head and tubercle of the normal rib ossification begins at fifteen years and is completed at about twenty-three years. "It is obvious, therefore, that a cervical rib will tend to become progressively larger, more fixed, and have greater tendency to cause pressure symptoms between the ages of fifteen and twenty-five years."

Treatment. The majority of cases of cervical rib require no treatment whatever. For those who are suffering pain, which is the most frequent reason leading the patient to consult the surgeon, it is right that medical treatment should first be tried and that we should not rush heedlessly to a surgical operation, unless the conditions warrant it. For example, cases in which the patient is suffering *severe* pain, or when gangrene of the tips of the fingers is either present or impending, admit of no delay. But inasmuch as there are several cases on record in which the patient has not been bettered by operation because of a concomitant progressive central nervous disease, such as syringomyelia, it would be right, if delay is possible, to test the effect of medical means until sufficient time has shown that this will do no good, or that the case is not simply one of cervical rib, but of a much graver condition of the central nervous system. These medical means are first of all rest, combined, it may be, with massage, liniments, electricity, and douches. If the patient's general health is poor, as is so often the case, of course this should be attended to and suitable hygienic and therapeutic measures should be instituted. If the case is supposed to be one of aneurysm,

pressure by a pad and bandage may be applied. While remedies to quiet the nervous system and possibly hypnotics for the purpose of procuring sleep and relieving pain may be desirable in some instances, yet their prolonged use, and still more the use of opium in any of its forms, is certainly to be condemned. If the case is severe enough to require large doses of morphine with any frequency, it is severe enough to require operation.

On the other hand, delay that may permit thrombosis to occur and, especially, to progress even to gangrene, or to allow the muscles, because of the interference with their vascular or nervous supply, to atrophy and become useless, and the joints to become partially ankylosed is even more to be condemned. Each case must be judged upon its own merits and by its own symptoms and dangers.

Operative Treatment. The rapid increase in the number of operations as the condition has been more readily diagnosticated, and especially since the *x*-rays were discovered, in 1895, is remarkable. In the thirty-five years from 1861 to 1895 only eight operations are recorded. In the five years from 1896 to 1900 nine more are recorded. From 1901 to October, 1906, inclusive, that is, less than six years, twenty-five cases have been published.

The most important fact as to the whole series of operations is that the *mortality has been absolutely nil.* Not a single patient died as a result of the operation nor was a single one seriously ill, excepting those few cases in which other diseases of the nervous system, especially syringomyelia, were present. In a few the result has not been all that could be wished, but in the great majority it has been most satisfactory. In only three cases has there been recurrence, necessitating a second operation in two. In Beck's case a subperiosteal resection was followed by reproduction of a centimeter of the rib and recurrence of the symptoms. In Lilienthal's the symptoms were thought to be due to the cicatrix. No second operation was done. In Marburg's case the symptoms persisted and a second operation was done, but the persistent symptoms were probably due to the syringomyelia. In no case has a bilateral operation been required.

Operation. Three different incisions have been used: First, horizontal or nearly so, that is, parallel with the clavicle, similar to that by which we ligate the subclavian artery. Second, vertical or obliquely vertical at a suitable position and angle between the sternocleidomastoid and the trapezius muscles. Third, a combination of these two, either by an incision, one limb of which is parallel with the clavicle or nearly so, and the other more or less nearly vertical, meeting the horizontal one at the anterior end, or at some point in its course. The last one was the incision I adopted. It is, I think, a matter of indifference which of these methods is adopted. Each operator will select the one which is best, in view of the development of the rib and the depth to which the dissection

must be carried. In a long thin neck the vertical incision would be the best; in a short stout neck a combined incision. When the patient's neck is of medium length and there is moderately thick subcutaneous fatty tissue a horizontal incision would very probably give sufficiently wide access. The main thing, no matter what incision is adopted, is to have plenty of "elbow-room."

Misled in his diagnosis, thinking the case one of malignant disease of the vertebræ, Brewer divided the clavicle. No harm came of it. But this is not a necessary step. In Williams' case it was considered, but rejected.

Exposure of the Tissues. Sometimes the superficial vessels in the neck are in the way either by their size or position. In these cases, whether artery or vein, they should be doubly ligated and divided. By blunt dissection we then approach the tumor formed by the rib and expose the brachial plexus and the artery. Sometimes the one or the other may not be seen. The vein is rarely seen, but its presence should always be remembered lest inadvertently it may be wounded. So, too, injury to the phrenic nerve must be carefully avoided.

The rib is now exposed by blunt dissection both anteriorly and posteriorly as far as is either possible or necessary. Very commonly if the rib is of considerable length, the scalenus anticus and very possibly the medius and posticus may be inserted into it. In such case the muscle must be separated by scissors or knife from the bone.

In isolating the rib, one of the chief dangers is the dome of the pleura. In my own case I did not see it. Although the patient was rather thin, there was sufficient fatty tissue in the neck to obscure it and it never came into the operative field. In other cases it has not only been seen, but sometimes it has been very difficult, or even impossible, to avoid injuring it. In five cases it has been torn to a greater or lesser extent (Planet, Patterson, de Quervain, Brewer, and Tilmann). In no case, however, has this proved to be a serious complication. The moment that it occurs the surgeon is aware of it by the noise of inspiration and expiration. The opening should be instantly closed by the finger and then by packing with iodoform gauze. A slight local pleurisy may follow, but in most cases only a passing trouble has resulted from this accident.

The rib is then removed as far as necessary both backward and forward, either by the chisel, the Gigli or other saw, or the bone forceps, the stump at each end being rounded off by the rongeur forceps. It is important that the stumps, especially the anterior one, whether this is the anterior end of the rib or an exostosis on the first rib, should be sufficiently removed, lest, as in Gordon's case, the subclavian is "slung" over the projection and thus still seriously interfere with the circulation. (Fig. 5 shows the stump in my own case.) In Tilmann's case it was a cause of annoying pain. If the anterior extremity is free, it facilitates removal. If

the rib is attached to the first dorsal rib, and especially if this is a bony attachment, it makes its removal somewhat more difficult. In this manœuver the pleura, of course, must be very carefully protected from injury.

While it is generally recommended to remove the periosteum with the bone, this was not done in Borchardt's case (No. 11), and there was no reproduction of the rib as shown by a skiagraph four years later. Rafin also followed this method. Israel even advocates subperiosteal resection. But, as removal of the periosteum does not materially add to the difficulty of the operation, and as Beck's case showed that reproduction did actually take place and required a second operation, the periosteum should always be removed with the rib.

In uncovering and removing the rib, the brachial plexus should be drawn outward and upward and the artery downward and inward. So far as the artery is concerned, its walls are usually so strong that there is little danger of doing it injury. No surgeon capable of such an operation would probably injure the artery. There is no such instance on record. With the plexus, however, it is different. In order to uncover and remove the bone, several operators have been obliged to drag upon the plexus so seriously as to produce severe pain for several days after operation, and in some cases partial or complete paralysis of the arm (Gordon, Borchardt (No. 18), Ranzi, Marburg, and Patterson). In the great majority of cases, both the pain and the paresis or paralysis have only been temporary, but in a few cases they have been a very serious and more or less permanent sequel. It warns us, therefore, to be on our guard and to handle the plexus with as great gentleness as possible.

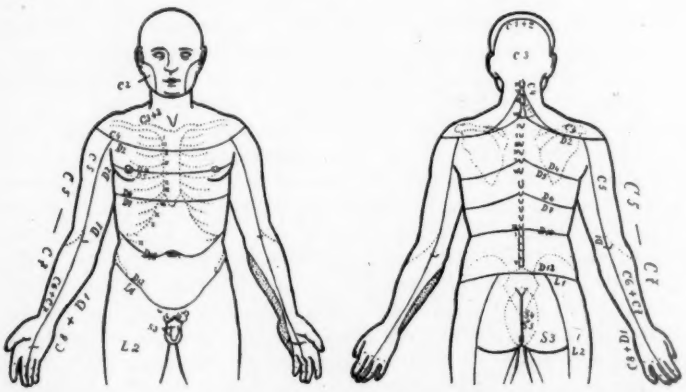
As soon as the rib is removed and the ends smoothed off the artery and plexus sink into the gap felt by the resection, and no further attention need be paid to them. The wound is closed in the usual manner, with or without drainage as may be thought desirable. de Quervain warns against drainage in case the pleura is torn on account of the possible danger of emphysema. Usually the wound is entirely healed in the course of a few days with but little if any reaction.

The after treatment should consist of massage of the arm, electricity, and passive and active movements in order to restore the usefulness of the hand and arm.

Case 32. Hugh T. Patrick and William E. Morgan (personal communication). Woman, aged twenty, no occupation, first seen September 24, 1904. Three or four days, or possibly more, before examination the left arm began to ache with an almost constant dull, "dead" pain. About eighteen months before examination she had noticed some disability of the left hand and arm. Found she would drop things, and noticed it was difficult to do up her hair.

TABLE OF 42 CASES OF CERVICAL RIB THAT HAVE BEEN OPERATED ON FROM 1861 TO THE AUTUMN OF 1906, ARRANGED IN CHRONOLOGICAL ORDER.[6]

No.	Author.	Operator.	Date.
1	Coote	Coote	1861
2	Planet	Périer	1889
3	Fischer	Fischer	1891
4	Ehrich	Karg	1891
5	Ehrich	Madelung	1894
6	Tilmann[7]	Bardeleben	1894
7	de Quervain	de Quervain	1895
8	Warren	Warren	1895
9	Czerny	Czerny	1897
10	Grounauer	Grounauer	1897
11	Borchardt	v. Bergmann's Clinic	1897
12	Williams	Williams	1897
13	Thorburn	Thorburn	1898
14	Gordon	Gordon	1899
15	Kiderlen	Schede	1899
16	Ranzi	Friedlander	1899
17	Rafin	Rafin	1899
18	Borchardt	v. Bergmann's clinic	1900
19	Borchardt	v. Bergmann's clinic	1901
20	Borchardt	v. Bergmann's clinic	1901
21	Brewer	Brewer	1901
22	Israel	Israel	1901
23	Kammerer	Kammerer	1901
24	Pancoast	Frazier	1901
25	Ranzi	v. Eiselsberg	1902
26	Riddle	Riddle	1902
27	Dejerine & Armand	?	1903
28	Thomas & Cushing	Cushing	1903
29	Thorburn	Thorburn	1904
30	Marburg	v. Eiselsberg	1904
31	Murphy	Murphy	1904
32	Patrick[8]	Morgan	1904
33	Beck	Beck	1905
34	Babcock	Babcock	1905
35	Hauswirth	Berg	1905
36	Lilienthal	Lilienthal	1905
37	Patrick[8]	Plummer	1905
38	Keen	Keen	1905
39	Murphy	Murphy	1906
40	Sargent & Buzzard[9]	Sargent	1906
41	Laplace[9]	Laplace	1906
42	Patterson[9]	Patterson	1905



FIGS. 22 and 23.—Front and rear views of Patrick's case (No. 32). Tactile anesthesia, with slight hyperalgesia of the left forearm, slight in degree and with ill-defined border.

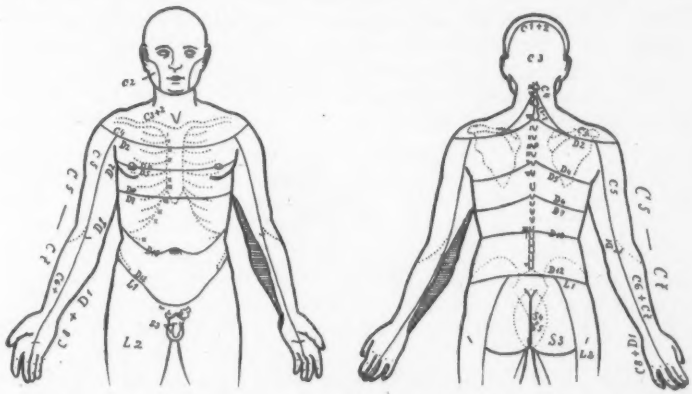
[6] In the Bibliography (arranged alphabetically) the references to all of these cases which have been published will be found. It has not always been clear who was the operator and, therefore, I may have incorrectly stated the name in a few cases. Abstracts of many of the earlier cases are given by Eisendrath, Pilling, and Schönebeck. Of the unpublished cases brief histories are given below. I have to thank the surgeons who have communicated these various cases to me personally.

[7] This case is also reported in Kuester's Inaug. Dissert., Berlin, 1895, and is often referred to as his or as Bardeleben's.

[8] As Dr. Patrick's cases were published in such very brief abstracts, I give here considerably fuller histories, which I owe to his kindness. Cases 38, 41, and 42 are also from notes kindly furnished by the operators.

[9] Not yet published.

After any unusual exertion, pain in the arm was increased; occasionally kept her awake at night. At about the same time she began to notice a numb feeling and paresthesia along the inner border of the left arm, forearm, and hand. Of late she has noticed that the left hand was not so sensitive as the right, and a few days before being examined she burned the ulnar side of the wrist and noticed that it was not normally painful. There was atrophy of the small hand muscles and beginning claw-hand. Measurements showed a difference of ½ inch in the circumference of the hands, ¼ inch in the forearm, and ¾ inch over the biceps. There was slight flattening of the region of the left supraspinatus, slight wasting of the deltoid. In the action of shoving the left scapula "winged" a little more than the right. The grip was slightly weak on the left side and, in grasping strongly, the hand turned slightly toward the radial side. The



FIGS. 24 and 25. Front and rear views of Patrick's case (No. 32), same as Figs. 22 and 23. Area of thermo-anesthesia (incomplete) of left arm; border indistinct.

palpebral fissure was slightly smaller on the left side and in obscure illumination the left pupil was slightly larger than the right. There was slight but distinct thermo-anesthesia along the inner border of the arm and forearm from the wrist (not including the hand and little finger) nearly to the axilla. Along this border there was also some tactile anesthesia, but smaller in area than the thermo-anesthesia (Figs. 22 to 25). There was reaction of degeneration in the small hand muscles.

Operation, October 25, 1904, by Dr. William E. Morgan. No particular difficulty was encountered at any stage. The patient made a good recovery from the operation, although she experienced a good deal of pain for the first two or three days. No later history was obtained.

Case 37. Hugh T. Patrick, and S. C. Plummer (personal communication). Woman, aged twenty-four, bookkeeper and stenographer, first seen January 25, 1905. Pain had begun in the right axilla eight years before and had gradually extended down the inner border of the arm, gradually becoming worse. Any overexertion, such as prolonged writing or piano playing, increased the pain, and she positively affirmed that any undue excitement had the same effect. About four years before being seen, she first noticed disability in the fingers, in trying to pick up a pin. Three years before, loss of power in the thumb had reached such a degree that she could not hold a pencil in the ordinary way, and was forced to hold it between the index and middle fingers. By January, 1905, there was not only weakness in the small hand muscles, but the whole right arm was weaker. The pain seemed to start in the axilla and run down to the elbow and middle of the forearm, along the inner border. She had no pain in the hand or fingers, but occasionally pain seemed to extend from the axilla around to the scapular region. She did not know when the wasting had begun, but when she first noticed it two years before examination it had already become quite marked.

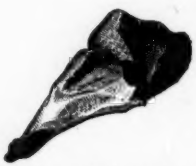


FIG. 26.—Specimen removed in Patrick's Case 37. (Natural size.)

In the history of this case it is rather interesting to note that a diagnosis of writer's cramp had been made by a prominent neurologist, because of the difficulty in writing and the distress caused by it. Measurement showed the right hand, forearm, and arm each ¼ inch smaller than the left.

No distinct anesthesia could be made out. The skiagraph showed not only a cervical rib on the right, the affected side, but also one on the left almost as large. As the left rib has caused no symptoms, of course it has been let alone.

Operation, March 16, 1905, by Dr. S. C. Plummer. Incision, three inches long, from clavicle at posterior border of sternocleidomastoid muscle, obliquely upward and backward. Skin and platysma divided, also a part of trapezius and of sternocleidomastoid, as these two muscles came close together, and the portions cut were quite thin. Brachial plexus exposed. It was not necessary to expose the subclavian artery. The posterior belly of the omohyoid muscle was exposed, and drawn forward and downward, along with the plexus and artery. The scalenus medius was laid

bare and retracted backward. There were no muscular attachments to the cervical rib. The cervical rib was now freed and cut off at its base with a chisel. A portion of the remainder of the rib was cut away with rongeur forceps. The rib was 1¼ inches long and ⅜ inch wide at its widest part (Fig. 26). Its anterior end was pointed and connected with the first dorsal rib by a slight ligamentous band. No injury to pleura. Catgut sutures in muscles. Silkworm-gut in skin. No drainage.

After the operation she suffered very considerable pain above the clavicle, about the site of the operation, not under the arm and along its inner border, as heretofore. This pain continued for about six weeks without much change, when it gradually diminished. However, as soon as the patient began to use the arm, such use caused pain in the scapular region, and if the exercise was continued the whole arm began to ache. There has been constant but very slow improvement. The patient was last seen on August 10, 1906, and while the pain and tenderness above the scapula had almost entirely disappeared and she had no pain in the arm when quiet, exertion of almost any kind, if continued for more than twenty or thirty minutes, caused first discomfort, and then a decided ache. As regards atrophy, strength, and function of the hand, it could not be said that there had been any improvement. On the whole, the results of operation were disappointing, although it is reasonable to suppose that improvement will continue for a long time.

Case 38. Francis D. Patterson (personal communication). Woman, aged thirty-five, had suffered from children's diseases; diphtheria at fifteen; quinsy at twenty-one; malaria at twenty-four; rheumatism at thirty-one; typhoid at thirty-four. At twenty-eight she was operated on for an ovarian abscess.

July 19, 1905, at thirty-five years of age, she noticed a swelling on the right side of the neck, with pain in the distribution of the brachial plexus. A cervical rib was diagnosticated. She was operated upon August 2, 1905, by a vertical incision along the posterior border of the sternocleidomastoid. The pleura was punctured and a late pneumothorax developed. Uninterrupted recovery took place, but a pressure paralysis followed, probably as a result of the forcible retraction of the brachial plexus. All the earlier symptoms, caused by the cervical rib, had steadily improved up to January 6, 1906.

Dr. Rhein examined the patient October 26, 1905. There was complete paralysis of all the muscles below the elbow, except that there were feeble pronation and supination. Flexion and extension of the fingers absolutely lost; deltoid unaffected, but pectoral muscles weak; latissimus dorsi, supraspinati and infraspinati intact; biceps and triceps, especially the latter, very weak. Marked tenderness along the nerve trunks. Straightening of the fingers caused great pain. No loss of sensation either to pin-point, heat or cold.

There was some hyperesthesia of the left hand. Faradic contractility was present in all of the muscles, but diminished in the extensors, flexors, triceps, and biceps; the deltoid was normal. There was reaction of degeneration in biceps and triceps, flexors, in the forearm and the small muscles of the hand. The cathodal closures were greater than the anodal in the extensors of the forearm. The prognosis was good.

Case 41. Laplace (personal communication). G. H., aged eighteen, first seen December 4, 1905. On October 17, 1905, while looking out of the window of a train, was frightened by another train passing by, and hurriedly drew his head in, knocking his right shoulder against the window. He was unconscious for about fifteen minutes. When he awoke, he was unable to raise his right arm. Was treated for six weeks by his family physician, without improvement.

Physical Examination. December 4. The patient, though only eighteen, is six feet in height; is quite thin. Has grown very rapidly during the last two or three years. The right shoulder seems especially emaciated. He is unable to raise the right arm. There is considerably atrophy of the deltoid, biceps, and triceps. He is, however, able to flex the forearm and retains the power of pronation and supination. Sensation has remained about normal. Says that he is getting worse since the accident. Considerable bulging was noticed on the right side of the neck. On pressure it was found quite hard and gave considerable pain. The presence of a cervical rib was then suspected. An *x*-ray photograph revealed a cervical rib on both sides, though better marked on the right.

Operation, January 25, 1906. A curved incision was made in the posterior triangle commencing at the centre of the posterior margin of the sternomastoid, curving backward and downward to the anterior margin of the trapezius and then forward along the clavicle to the sternomastoid again. The flap was raised forward, and the deep facia was opened. The sternomastoid was pulled forward, and the subclavian artery and brachial plexus were defined lying upon the rib. The periosteum was incised and the rib was bared. It was found fixed at both extremities. Below, it seemed to be inserted into the sternoclavicular articulation. About four inches of rib was resected with cutting pliers and carefully shaved down so as not to leave any marked projection or sharp edge, against which the vessels or nerves might be damaged. The periosteum was then resected. The wound healed without trouble, but as yet the paralysis of the circumflex and subscapular nerves has not been relieved. About ½ inch of the rib was left adherent at its anterior insertion, fearing to wound the subclavian artery and vein by working any deeper.

Case 42. Mr. Percy Sargent and Dr. Farquhar Buzzard, of London (personal communication). Woman, aged forty-nine.

For ten years she had complained of inconstant dull aching pain in the ball of the right thumb; worse in evening and after muscular exertion. Three or four years ago numbness in tips of right thumb and forefinger was observed. One year ago atrophy of the ball of the right thumb was noticed, and at the same time she began to have aching pain in the internal aspect of the right forearm and over the deltoid. She had occasional pain above the right clavicle. A year ago the numbness extended to the tip of the middle finger. On admission the only muscle affected was the right abductor pollicis; the thumb movements were scarcely interfered with excepting in abduction. For the sensory area, see diagram (Fig. 27). A skiagraph revealed bilateral cervical ribs, but they could not be definitely felt. The subclavian arteries were raised well above their usual levels.

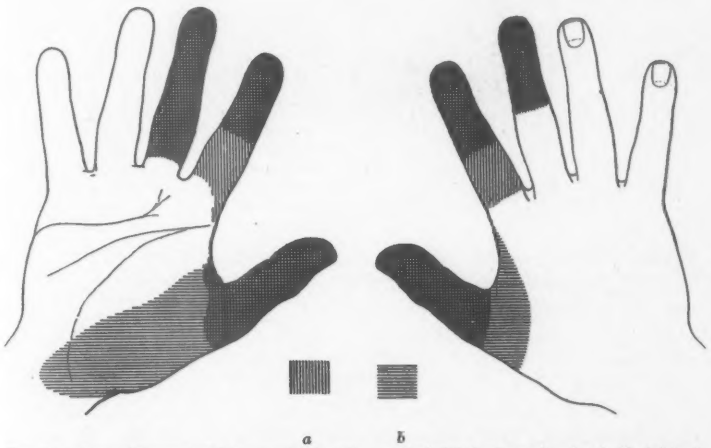


FIG. 27.—Case of Sargent and Buzzard (No. 42). *a*, diminished sense of pain; *b*, diminished tactile sense. The darkest areas represent diminution of both.

Operation, July 17, 1906, by Mr. Sargent. Triangular flap of skin corresponding to posterior cervical triangle; exposure of plexus; complete rib found, articulating with the seventh cervical and attached to the first rib. An angular prominence existed in the middle. "There was no indication that any part of the plexus was pressed or dragged upon in any way."

After operation the whole upper extremity was extremely weak. Sensation was unaffected. September 15, 1906: the arm is recovering, but there is still some wasting of the spinati, deltoid, biceps, and triceps. Sensation is the same as before operation. No definite electrical changes exist in any muscle. October 23, 1906: recovery of muscles of the fifth cervical segment is very slow.

POSTSCRIPT.

After this paper was in print, Dr. J. M. Spellissy, of Philadelphia, reported at the Academy of Surgery of Philadelphia the following case. I owe to his kindness the advance notes of the case before publication and also the photograph of the most complete specimen of cervical rib which I know. It shows a most extraordinarily deep groove for the subclavian artery (Fig. 28).

M. R., aged twenty years, was first seen in May, 1905, for a painful right shoulder, following a fall over two years previously. Exami-

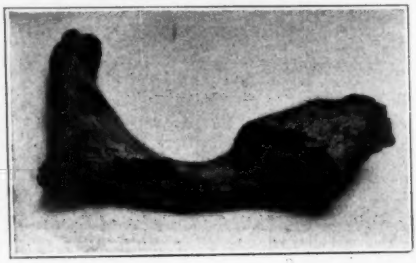


FIG. 28.—Cervical rib (natural size), with very deep groove for the subclavian artery. (Spellissy's case).

nation showed a sternal luxation of the right clavicle and the presence of a right cervical rib. A skiagraph confirmed the diagnosis. There was no cervical rib on the left side. Excision was done by Dr. Spellissy on May 22, 1905. The anterior end of the cervical rib articulated with the first dorsal. This end was disarticulated, and after freeing the under surface of the rib and dissecting the artery loose for 5 cm., with considerable difficulty the artery was displaced over the anterior end of the rib. The rib was then disarticulated from the seventh cervical vertebra. The patient made a good recovery.

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COMPULSORY VACCINATION, ANTIVACCINATION, AND ORGANIZED VACCINATION.

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The antivaccination movement in the United States is becoming widespread and troublesome. The first suit at law against legalized vaccination was brought in 1890.[1] Since then there have been many, and although the decisions almost unanimously favor the health authorities, litigation seems on the increase.

For the last eight years we have been passing through an epidemic of smallpox, and this showed, in strong colors, the need of more vaccination rather than less. I believe that legal regulation is needed, but I also think, and shall try to show, that our present laws are unsatisfactory in their results. If laws are made, they should be so constructed and enforced as to secure the sanction of public opinion. I need not discuss the fiction that in a republic all laws come from the people. This at least is true, that some kinds of laws cannot be enforced unless they have popular acquiescence. Unpopular health laws affecting the person will find difficulties such as arise in the execution of sumptuary laws, like those regulating the use of tobacco and alcoholic beverages. Even among people with despotic or paternal government, with highly organized civil service and active police, vaccination is sometimes defeated. Mothers suck out the virus from their children's arms with great danger to themselves; older subjects wash out their wounds; dishonest physicians give false certificates; venal officials connive. In our own country some legally qualified practitioners of medicine are opposed to vaccination and give certificates for absurd substitutes, such as variolinum, or diluted smallpox virus, given by the mouth.

[1] Abeel *vs.* Clark, 84 Cal., 226.

What we need, in my opinion, is not statutory compulsion, our first antidote against all evils, from corsets to obnoxious corporations, but an organized and scientific procedure that shall have the confidence and support of a large majority of the people, and shall have no weak spots in any part. Many antivaccinationists are both ignorant and fanatic, but more are merely ignorant. If as serious an effort were made to convert them to vaccination as is now made to turn them the other way, I believe, on the basis of some experience, that they would easily submit. Perhaps the most important objectors are quiet but influential people whose opposition has been aroused by some real or fancied injury wrought by the operation, or by the exaggerated or baseless claims of its advocates. A proper method would turn these into active supporters of general vaccination. Medical writers and health officials too often follow a more arbitrary course, as shown by the following extract from a work on therapeutics excellent in most particulars: "After all is said and done, the final decision of the subject [vaccination] rests with the medical profession; for, in the first place, it alone can properly interpret results." Of course, the final decision does not rest with the medical profession. Even if it did, the results should be capable of being understood by any intelligent and unprejudiced mind.

Let me try to show why we need better vaccination, and how it may be secured. We are now in the later stage of a smallpox epidemic that began soon after the Spanish war, and spread over most of the United States. The exact extent and severity cannot be accurately stated. The most complete data are those of the Public Health and Marine Hospital Service, but owing to the method by which they are collected, these are necessarily imperfect. Taking the figures[2] as given, however, we find the following:

Smallpox Cases and Deaths in the United States.

Years.	Cases.	Deaths.
1899	11,136	553
1900	20,362	819
1901	48,206	1,127
1902	54,014	2,083
1903	40,676	1,448
1904	17,965	709
1905	20,099	354
1906 (first half)	8,542	53

The decline of the epidemic does not mean that the disease is being stamped out finally. It is certain that unless something more is done in the next few years than has been done before, another general epidemic will occur, or numerous local epidemics, just as in the past.

The death-rate has, on the whole, been low, but this also cannot be assumed to be a general or permanent feature. At all times

[2] Public Health Reports.

in the history of smallpox mild cases have been observed, and it has been known that a mild case or mild epidemic may give rise to a severe case or a severe epidemic.

The view has been advanced that the recent mild type is due to hereditary immunity caused by vaccination of parents. There is no proof for this, and it may be a very dangerous idea if followed out. Against it may be said: (1) Vaccination in the United States has not been as widespread as this contention assumes. (2) In some localities where there were severe cases there is no reason to think the parents were relatively or absolutely less protected. So in Cleveland, in 1901, there were 1230 cases of smallpox with 20 deaths, or 1.6 per cent.; in 1902, 1298 cases with 224 deaths, or 17.3 per cent. Vaccination protects the individual, as smallpox does, but the latter does not make immune the children. It is probable that the mild type of the recent epidemic is due to causes partly separate from vaccination and not profitable to discuss at this time.

As the death-rate has been low, the total deaths are hardly enough to give the public much concern on that score. A country that sees its citizens killed off in their best years by typhoid fever without making a move to prevent the disease; that is so indifferent to accidental deaths and homicides in all forms, is not likely to pay much attention to the loss of a few hundred people a year from smallpox. Much more serious to a larger number are the sick. Through these discomfort and inconvenience affect many people, and the mild character of recent smallpox has not greatly lessened the horror traditionally associated with it. It is true that patients in well-managed smallpox hospitals often say they would rather have smallpox than be vaccinated. Many people, especially the ignorant in isolated districts, often have smallpox epidemics without paying particular attention to them. But most people have a fear that is justified by the painful symptoms, dangerous sequels, and high infectiousness of the disease in the unvaccinated. The newspaper account of the treatment of George Francis Train may not have been true, but its publication in journals not of the yellowist kind indicates the general feeling. It also shows how much that is irrational and absurd can be attributed to the medical profession. I have taken the following account from a city paper, where it appeared in double column, with picture, "scare-heads," and display type:

"Make a Row when Disinfected. Stamford, Conn., June 17, 1903. Kicking and shouting and resisting with all his might, 'Citizen' George Francis Train was carried from the smallpox pest-house in Stamford yesterday—and laid in sheets beneath the open sky. Then the physicians made a bath of hot bichloride of mercury, into which the old gentleman was lifted. As soon as his nose was shoved into the bath, Mr. Train burst forth into loud protests against the treatment he had received, bemoaning especially

the destruction of the beloved manuscript of his autobiography. Pinned in sheets soaked in bichloride of mercury, he was carried to a closed carriage, in which he was conveyed to the residence of his daughter. The physicians and attendants left immediately."

While this may be overdrawn, we usually see general alarm, quarantine of suspects, house inspection by ignorant, brutal and sometimes dishonest and dissipated officials. Even in intelligent localities sometimes men of standing guard their neighborhood with shotgun cordons, giving an example of fear and lawlessness worse than pestilence. Wrecking of houses set apart for smallpox patients is a common occurrence. It is not many years since two expressmen were quarantined in Brooklyn because the commissioner of health thought they might become exposed to smallpox or carry it in the course of their business. The disease was prevalent and they refused to be vaccinated. Habeas corpus proceedings were necessary to release the victims from the "unwarranted and extraordinary" situation, to use the words of the judge in the final trial.[3]

Great expenditure of money is an essential part of the present method. Few places have special hospitals, and still fewer permit smallpox patients to enter general hospitals. Unfit locations, naturally and accurately termed pest-houses, must be obtained at exorbitant cost; special physicians, attendants, guards, and supplies raise the expense still higher.

But perhaps the greatest evil of all is the fact that at such times most of the vaccination has been done, by unfit persons often, on an alarmed and uninstructed public, with inferior and often wretchedly faulty virus. No wonder that some health officers, like the one in Cleveland, in 1902, stop vaccination in sheer terror at its abuses, and, depending upon the baseless hope of disinfection and quarantine without vaccination, invite still worse disasters. Such experiences form the most effective weapon in the scanty arsenal of the anti-vaccinationist, like an old-fashioned blunderbuss, useful only against a rash but undisciplined foe.

But these experiences we cannot escape so long as we adhere to our present method, or lack of method, of managing smallpox and vaccination, and so long as human nature remains as it is. Periods of relative freedom will occur, lasting for a few years, and then, as soon as a sufficiently large unvaccinated population collects, chance infection will start up epidemics, as it has hundreds of times in the past. If there was no other way, if we were as helpless now as we were 200 years ago, or as we are now against cyclones and earthquakes in their peculiar areas, the condition would be bad enough. As it is, we have the lesson of an immense experiment, carried on long enough and on a scale large enough to furnish conclusions of definite value.

[3] In re Smith et al., N. Y., 146, p. 68, 1895.

This experiment has been made in Germany. The population there is not as large as our own, but large enough for a just comparison. (U. S., 1900, 76,303,387; Germany, 56,006,254.) The German people have no keener interest in private hygiene than our own, and public sanitation, in which they excel us, plays a minor part in the prevention of smallpox. The country is surrounded on three sides by neighbors with whom it carries on active intercourse, and all of these other peoples, up to the present time, have been relatively less protected by vaccination. Smallpox has been fairly prevalent in Austria, Russia, and France, less so in Holland, Belgium, and Switzerland, but always more than in Germany. For example, Warsaw in 1900 had more than 350 deaths from smallpox; Austria 999 cases and 143 deaths in the same year. The German vital statistics are kept with great care. It is a lesson in public service to read one of the annual reports of the Imperial Health Office.[4]

Smallpox Cases and Deaths in Germany.

Year.	Cases.	Deaths.
1900	390	48
1901	375	54
1902	114	16
1903	172	19

The tables show that in the same years I have quoted for the United States, Germany had only a fraction of our smallpox morbidity and mortality. The experiment further shows that this difference is not due to lucky chance. Similar favorable conditions have prevailed for the length of a human generation. Before that, from a short time after Jenner's discovery was published, many German states were distinguished alike by widespread and careful vaccination and favorable smallpox statistics; but this was not as perfect as many antivaccination writers assume. In 1870–71 all Europe suffered seriously, but, as an unusual feature of war times, the German army had a smaller proportion of cases, not only than the opposing army, but also less than the civil population at home, of corresponding ages. The only explanation for this was the more perfect vaccination of the military. Soon after the formation of the Empire, in 1874, systematic vaccination and revaccination were required by a carefully prepared law, and since then it has had a freedom from smallpox such as no other country in Europe or America can boast. Moreover, the few cases that do occur can be traced in large part, one-fourth in some years, to persons who had entered the country from a less protected land—railroad laborers from Italy, brickmakers from Hungary, farm hands from Russia. Some can even be traced to our own country, as in 1901, when several cases were due to infection from Utah, carried by delegates to a

[4] Taken from the Med.-Stat. Mittheilung a. d. Kais. Gesundheitsamte.

Mormon Congress! Another large proportion is in infants not yet vaccinated. Vaccination and revaccination are the only possible causes of the difference, for shotgun quarantines are unknown and isolation hospitals hardly ever used for smallpox patients. Some are treated in their homes; some in general hospitals, even in wards with other patients. The disease rarely spreads beyond the first case. No one in Germany thinks the methods perfect. They are improved from time to time in various ways. Doubtless the future may show a better way of preventing smallpox than the present German method. Hitherto it has not been found. Some other countries have recently imitated it, with unessential modifications, notably France, Japan, Spain, Portugal, Argentine; even Turkey is making an effort, and Brazil would have adopted it but for a close relation between the vaccination project and an unlucky political party.

The two great countries that speak Jenner's language are among the last to adopt a practical and efficient system and also among those most devastated by smallpox.

In the United States the conditions are peculiar and extremely complicated. Many imagine that, owing to the high degree of intelligence of the public, voluntary vaccination is perfectly carried out. If this were so some other explanation than the one I have given for the existence of smallpox epidemics would be necessary. So careful a student of the subject as Voigt, in a recent report, quotes the *Lancet*[5] to the effect that 90 per cent. of our population is vaccinated and about half revaccinated. I cannot tell how the *Lancet* correspondent got his information. Early in the epidemic I made an examination of several hundred adults from all parts of Michigan and a few from adjacent States, where the vaccination laws are about as good and about as well enforced as the average, and I found only 60 per cent. vaccinated, and of these the majority had scars that were not at all satisfactory. Even public institutions, such as insane asylums, contained many unvaccinated people. In one of the best, out of 50 inmates who got smallpox in a short time, in 1901, only 17 had been vaccinated, "none recently, and with some the scar was barely visible."[6] Since then there has been much smallpox all over the State and a great deal of wholesale vaccinating, but in 1905 I found one-third of adult hospital patients wholly unvaccinated and almost none with good scars.

Voluntary vaccination can never be depended upon to prevent smallpox epidemics, nor should it be, for it is not done only for the protection of the person vaccinated, but for all. Moreover, the protection of the individual may be imperfect, and the population in general gets good results only when a large proportion of all are

[5] 1905, ii, 1142.

[6] An Epidemic of Smallpox at the Michigan Asylum, etc., Arthur MacGugan. Medical News December 14, 1901.

most thoroughly protected. It is true that some cities, such as New York and Chicago, have been pretty thoroughly vaccinated for some years past, but the conditions over the country in general are more important, and even lessen the value of the thorough vaccination in a few places.

The error regarding the extent of efficient vaccination has caused one of the most serious fallacies of antivaccination writers. They do not seem to appreciate the obvious fact that imperfect protection is the result of inefficient vaccination, and they make much of the sickness and death among those supposed to be but not really vaccinated.

There is a prevalent idea, even among many medical men, that vaccination can never be regulated by law in the United States. As a matter of fact, it not only can be, but in many States is the subject of statutes, as I shall show in detail later. The chief cause of misunderstanding comes from ignorance of the fact that vaccination, like other questions of "public safety, health, and morals," comes under police regulations, under the jurisdiction of the separate States; but there is no real obstacle to efficient and even to uniform statutes in every State as soon as people want them. Perhaps some way will be found in time to place so important a matter as vaccination under federal control, either by an extension of the principles of the interstate commerce law or an expansion of the public health service. Central regulation would undoubtedly be an advantage. Taking, however, only the means at present available, we find that States can enact satisfactory vaccination laws if they desire to. "In a free country, where the government is by the people through their chosen representatives, practical legislation admits of no other standard of action (except that based upon common belief), for what the people believe is for the common welfare must be accepted as tending to promote the common welfare, whether it does so in fact or not."[7] The most important decision up to the present is that handed down by the Supreme Court of the United States, in Jacobson *vs.* Mass.,[8] affirming the decision of the Supreme Court of Massachusetts.

The law contested was a statute authorizing boards of health to enforce vaccination and revaccination of all inhabitants, and imposing a penalty upon everyone over twenty-one years of age, and not under guardianship, who refused or neglected to comply. In the same statute an exception is made in favor of "children who present a certificate, signed by a registered physician, certifying that they are unfit subjects." The discrimination alleged as to this exception was brushed aside as unessential. The defendant claimed that the statute was in derogation of the rights secured to him by the preamble of the Constitution and the Fourteenth

[7] Matter of Viemeister, 179 N. Y. 235, 72 N. E. 97. Am. State Rep., vol. 103, p. 863.
[8] 26 Sup. Ct. Rep., 358.

amendment. The court made short work of both claims. "Personal liberty," it said, "is not invaded when the State subjects (one) to fine and imprisonment for neglecting or refusing to submit to vaccination." It denied "that a competent vaccination law is unreasonable, arbitrary, and oppressive, and therefore hostile to the inherent right of every freeman to care for his own body and health in such a way as to him seems best. But the liberty secured by the Constitution of the United States to every person within its jurisdiction does not import an absolute right in each person to be, at all times and in all circumstances, wholly freed from restraints. There are manifold restraints to which every person is necessarily subject for the common good. On any other basis organized society could not exist with safety to its members. Society based on the rule that each one is a law unto himself would soon be confronted with disorder and anarchy."

No objection should be possible against the principles expressed in the above, and in any event the decision is likely to influence strongly all future questions touching the constitutionality of vaccination laws.

An acute legal writer[9] has recently drawn some far-reaching conclusions from decisions in cases involving vaccination laws that deserve careful attention from physicians. He shows that a uniform course of decisions establish the fact that it is a valid exercise of the power of police regulations to require vaccination as a condition precedent to the right to attend school. "The natural question arises: Have these decisions paved the way for future declarations in favor of the right of the Legislature to order compulsory vaccination of all persons—adults as well as children? Any requirement of law," continues the editor, "to be sustained as a valid exercise of police power must be a reasonable requirement." The courts have been guarded in expressing an opinion as to the preventive power of vaccination. Their decisions are usually based upon "common opinion," "the present state of medical knowledge," or "common belief." "The efficacy of vaccination is regarded by the courts not as an established fact." "But if a mere popular belief is sufficient to uphold a police regulation for one purpose, why not for another? If vaccination is a reasonable requirement as a condition precedent to the right to attend school, why is it not also a reasonable requirement as a condition precedent to the right to live in a community? In other words, if the legislature can say that no child can attend school unless he has been vaccinated, why can it not also say that no person shall reside within certain corporate limits unless he shall have been vaccinated?" This view, in fact, was upheld in a case in Georgia.[10] As regards school attendance, this is not merely a right or a privilege. In many

[9] Law Notes, December, 1904, p. 405.
[10] Morris vs. Columbus, 102 Ga. 792.

States it is compulsory. So it was decided in Matter of Walters,[11] that "inasmuch as attendance at school is compulsory and vaccination requisite as a right to attend school, vaccination is compulsory." As the editorial in question also says, "Courts under certain circumstances must uphold compulsory vaccination, even though forcible vaccination of a person against his will may be technically an assault."

In order properly to understand the present status and especially the imperfections of our vaccination laws, it is necessary to consider some of the enactments in detail.

Many States have no statutes regarding vaccination. In 1905 about twenty were in this condition, including some, *e. g.*, Illinois and Indiana, of great importance in population and geographical position. In such States, as in others, unless there is a statute to the contrary, the health authorities may make their own regulations, within certain limits, with or without special delegation of power for that purpose.

In Arizona (1903) general vaccination is obligatory, but the details to be observed are not prescribed. In Kansas,[12] "In case of smallpox a general and thorough vaccination shall be recommended and insisted upon." In Kentucky[13] all must be vaccinated, adults and minors; infants within twelve months of birth; persons coming in from other States, "to abide or become citizens," within six months, if not previously vaccinated. In Maine[14] vaccination is obligatory on all inhabitants over two years of age. In Maryland[15] all infants must be vaccinated within twelve months of birth. In Massachusetts[16] vaccination must be carried out in all persons under two years of age, unless excused on certificate of a physician by reason of unfit physical condition. In Mississippi a compulsory vaccination law was enacted in 1900, and the law amended in 1902, but the details are left to the local authorities. In West Virginia (1905) compulsory vaccination may be ordered upon petition of 100 voters of a county, in case of smallpox epidemic.

Revaccination is rarely mentioned, though often ordered indirectly. In some States general vaccination may be carried out in case of threatened danger from smallpox—Georgia, Massachusetts, New Hampshire, North Carolina, Oregon, Tennessee, Vermont, etc.

In Connecticut and Maine employees in paper factories are required to be vaccinated. Employers (in Connecticut) are obliged to "pay to any town all expenses caused it by the sickness of such person with smallpox contracted while so exposed." In Maine revaccination must be repeated in two years and all employees in paper mills must be examined twice a year with reference to the thoroughness of the vaccination.

[11] New York, 84 Hun. 457.
[12] Carroll Stat. 1903, C. 119.
[13] Gen. Stat. 1905, Sec. 3438.
[14] Rev. Stat. 1903, Chap. 18.
[15] Public General Laws, 1904, p. 1211.
[16] Rev. Laws, 1901, p. 682.

In Kentucky and North Carolina inmates of charitable institutions and the penitentiary must be vaccinated. In Massachusetts they may be at the option of the board of health, as may also operatives of manufacturing establishments.

In many States vaccination is a prerequisite to admission to the public schools. This is sometimes optional with local health boards, as in Connecticut, Georgia, Maine, New Jersey, Ohio, Oregon, West Virginia, and Wisconsin. In Wisconsin it has been decided that vaccination cannot be required as a condition precedent to the right to attend school.[17]

In some States the requirement is mandatory: the District of Columbia, Maryland, Massachusetts (except when excused by reason of unfitness), New Hampshire, New Mexico, New York, Pennsylvania, Rhode Island, South Carolina, and Virginia. In the Indiana school law there is a clause: "No child in good health and free from infection shall be excluded from the schools of Indiana, any law to the contrary notwithstanding." In Illinois[18] it has been decided that directors have no power to compel vaccination in the absence of smallpox. In Connecticut the existence of smallpox is not essential. In Minnesota[19] compulsory vaccination of school children is prohibited, except in case of epidemic, in children not excused by certificate as unfit. In Louisiana (1897) compulsory vaccination is prohibited. In South Dakota[20] physical force may not be used in vaccinating. In Utah a law to prevent compulsory vaccination was passed over the governor's veto in 1901. Teachers as well as pupils are required to be vaccinated in Virginia, Wisconsin, and also in New York City. Pupils of private schools are mentioned only in the laws of South Carolina.

The Territory of Hawaii[21] has a better law than any American State, but it does not go as far as is desirable. It includes such important desiderata as: A special vaccinator in each taxation division (other physicians may vaccinate); at least three convenient places in each school district for the performance of vaccinating; the operator must give notice of the times set for vaccinating and for inspection of results; these times must be at least once in every six months, oftener if required by the board of health; records must be kept and reports made; every child must be taken to the officer within six months of its birth, "or at the earliest opportunity after;" the child must be taken upon the eighth day after the operation so that the officer may ascertain by inspection the result of the operation; the result is to be noted in a book, and in case of successful vaccination a certificate given; if the child is unfit, the vaccinator may postpone the operation and notify the parent or person in charge of the "child to reproduce the same for vaccination at a future

[17] State ex rel. Adams vs. Burdge and others, 95 Wis. 390.
[18] Potts vs. Breen, 167 Ill., May, 1897.
[19] 1903, Cap. 299, p. 530.
[20] 1903, p. 297, Cap. 223, Sec. 1.
[21] Rev. Laws, 1905.

time;" there is a fine of five dollars for failure to observe the statute: "No child shall be admitted to any public or private school without producing a certificate of vaccination or showing marks of successful vaccination," under penalty of five dollars on the part of the teacher. Only bovine virus is to be used.

From the summary I have given it is obvious that there are very great differences in the scope of the laws regarding vaccination in different parts of the Union. This is not due to failure of sufficient constitutional basis for sound laws; nor is it due to public opposition to sound laws. Objections are made not so much to the statutes as to the manner in which they are enforced, or without any definite reason. Kentucky has one of the best laws, but there is no more opposition to it than there is to many weaker laws. Some of the statutes are so worded as to rouse latent or open antagonism even on the part of those who should enforce them. For example, in Maryland (1904) it is permitted to use human virus, "if practicable not more than four removes from the cow," a practice abandoned by all careful vaccinators. The fact that there is a penalty of one hundred to five hundred dollars for using defective virus does not relieve the anachronism of the earlier section. It is the duty (Sec.43) "of every practising physician . . . . to vaccinate all children in the circle of his practice which may be presented to him for vaccination, within one year, if such child shall be in a proper condition for such service;" and "all other persons not previously effectually vaccinated who shall request such service from him. Any physician neglecting or refusing so to do shall, on conviction thereof, forfeit and pay for every offense a penalty of five dollars." The advantages to be gained from the law are certainly not enough to warrant such demands.

In West Virginia, in the law of 1899, it was provided that certain agents were to send "genuine vaccine matter" and "directions how to use it," by mail or otherwise to every citizen of the State who applied for it, showing an enviable absence of the anti-movement, and a gross ignorance of the operation and its objects. In 1905 the law was amended, and "local option" vaccination and quarantine permitted in case of smallpox epidemic. "Competent physicians" can be appointed as public vaccinators, but in no case can they receive more than twenty-five cents for a successful vaccination, and no compensation for an unsuccessful vaccination. As "such physicians" have to provide their own virus, they can hardly fall under that part of the antivaccination complaint which alleges the medical profession upholds vaccination on account of the lucrative fees that the operation provides. As the State does not furnish any guarantee of the quality of the virus in the market, the injustice of the law is obvious.

A careful perusal of the statutes gives the impression they were devised without reference to the best methods available. The legal

part is usually correct, but the medical part seems to have been overlooked almost uniformly. A surprising lack of care is especially striking in the South Dakota statute of 1903:

"Sec. 1. It shall be unlawful for any board, physician, or person to compel another by the use of physical force to submit to the operation of vaccination with *smallpox* or other virus.

"Sec. 2. No person shall prevent a child of school age, who furnishes a physician's certificate of successful vaccination with *smallpox virus* within five years, from attending school."

It would be tedious and not profitable to discuss all the weak points in the various laws, and I shall criticise only the general bearings and important special features.

The laws are far too vague and uncertain to give such protection as is needed. It may be thought, and probably was supposed in framing statutes, that the best results could be obtained by making only general laws and leaving details to the officials who have to interpret and enforce them; but it is no more possible in this way to secure good results with vaccination than with other duties of society. We might just as well leave the protection of water supplies to public benevolence, as in fact we often have, with uniformly bad results. What we need is the widest possible application of the most efficient vaccination. Under any arrangement numerous officials are necessary for this. The best results so far have been obtained in certain cities where energetic and capable physicians have devoted themselves to the work. But men of that kind cannot be secured everywhere or always. Some are ignorant; some lukewarm; some opposed to the views or personalities of their superior officers. They may be hampered by red-tape or by lack of support, either financial, moral, or physically, from their superiors. So far as possible, then, accidental causes of failures should be reduced to the minimum by more explicit laws and more care in selecting officials.

The necessary thoroughness cannot be attained without accurate registers, which shall show the true condition of all persons with regard to perfection of vaccination and revaccination. We already have learned the advantages of lists of voters and of school children. It would add much to public order, and much advance the efficiency of vaccination and other sanitary details, to enlarge these lists and to enter various data regarding health and disease.

The method of combining vaccination and school attendance is very irrational, and yet in many States it is the main dependence. If vaccination is not done until the child begins school, as the natural tendency is at present, we leave the most highly predisposed part of the population—children under five or six years of age—wholly unprotected. A considerable part of the population may go unprotected even longer, because the children attend parochial or private schools, which in most States do not come under the statute.

The responsibility for the performance and even sometimes the success of vaccination is usually left to the teachers, who have not the proper training, and in most cases have not time to make the necessary examinations.

The laws sometimes require the impossible—*e. g.*, "successful vaccination of all pupils," Maryland, Pennsylvania; "successful or proper," Virginia; "successful" or "within one year," New Mexico; "proper," Rhode Island.) I do not mean that all people may not be successfully vaccinated. We all know that many vaccinations do fail. Even in Germany the primary success is not better usually than 85 per cent., varying from about 60 to less than 100 per cent. Not a few fail up to three attempts. In a recent news item,[22] it is stated that in the autumn of 1906 in Los Angeles, California, "more than 1000 primary vaccinations failed." "As the result of hot weather and exposure of the virus to high temperature *en route*," the account goes on to say, but the same exposure *en route* occurs all over the country, overheating in railroad cars being one of the stock excuses of the makers for weak virus.

The result is that a low standard of success is tacitly accepted everywhere, giving brief immunity or none at all. It is encouraged by assertions of makers of vaccine virus, by laws such as the one in West Virginia, and by the indifference to or lack of a careful noting of the results. In many places the patient is never seen by the vaccinator after the operation. And from the standpoint of education it is well that this is so. Notwithstanding all the current criticism of the public schools, in our present stage of development they are better than none at all. But if both education and vaccination are good, how unfortunate that they should be made to appear antagonistic, as they are at present in the public mind!

As a matter of fact, our experiment makes it plain that so theoretically perfect a requirement as we have in our school and health laws is not at all necessary. In Germany most children are vaccinated before they are two years old, and again at twelve. But there are many exceptions at both periods. From illness of various kinds many children are excused; in some, vaccination fails, but a certificate permitting school attendance is given (as it is in some few States in America). A few children remain unvaccinated illegally, or are imperfectly vaccinated and false certificates given. It is easy to see that these failures may in time become a source of great danger. Up to the present they have not been so great a source of danger as our stricter but impossible requirement. It is interesting to see that in Germany the question of compulsory vaccination has been decided in diametrically opposite ways by courts. Some fathers have paid their fines every year, on account of the non-vaccination of their children. Another obtained a

[22] Medical Record, October 27, 1906, p. 660.

decision showing that compulsory vaccination could not be made a condition precedent to attendence at school.[23]

Quite as faulty in its results is the law providing for vaccination in time of epidemic of smallpox. Even when the time is not left, as in West Virginia, to the good-will of the voters, the method has several weak points. Vaccination under the circumstances is too late for many people, as it takes time for the diagnosis to be made and the work of vaccination to be set in motion before a number of people are involved. Many people escape the operation, very often those who need it most. In emergency vaccination there is no consistent attempt at controlling or revising the result; many people who imagine they are well protected with or without scars, acquire the disease sooner or later afterward.

As epidemics often occur in different parts of the country about the same time, there is an excessive demand for vaccination, and inferior vaccine is put on the market, giving imperfect protection and more frequently causing septic infection. Sometimes there are other epidemic diseases at the same time that make operations dangerous—erysipelas, even tetanus. Owing to the haste required to vaccinate large numbers in a short time, those who know better hurry too much, many others who do not know assist in the work—physicians, servants or children, drivers, office-boys, or policemen. Many of the sore arms occur under these circumstances, either from careless operations, bad vaccine, or from operating on people who should have been excused. In the United States Supreme Court case of Jacobson *vs.* Massachusetts it was given out as impossible for unfit people to be vaccinated. It did not seem necessary to have a definite statement in the statute. As a matter of fact, we all know that many unfit people have been vaccinated, sometimes by force, with great brutality, and often with serious or even fatal results. There is no consolation for the parents in such cases to know they can bring suit for assault.

The omission of vaccination in such cases would not be nearly so dangerous as another method, legalized in one of the States, and practised in many—that of not vaccinating people living in sparsely settled regions. Yet these people very often have smallpox affecting patient after patient, often not seen by a physician, but occasionally moving to another place. Several patients have been admitted to the isolation hospital in Ann Arbor, having travelled many miles, sometimes hundreds, with smallpox. How many people exposed on trains, in stations, or in hotels have taken smallpox from such patients I cannot, of course, tell. From one sparsely settled district a woman travelled some distance with the eruptive stage well advanced, attended a wedding, and infected many people who reached almost as many towns before they knew what risks they had run. At

[23] Med.-Stat. Mittheilung a. d. Kais. Gesundheitsamte, Bd. viii, p. 61.

least six are supposed to have taken the disease from her. The experience of the hospital follows the universal rule—no student, physician, nurse, or patient has taken the disease from any of the smallpox patients. All of these are vaccinated as carefully as possible. One case only occurred from infection in the hospital, an orderly who was wrongly supposed to have been recently vaccinated. He was exposed only for a few minutes, while helping to carry a patient on a stretcher. The husband, who carried the other end, and was kept in the smallpox hospital, was vaccinated at once and did not take the disease.

All the faults mentioned depend upon the method of carrying out vaccination, and could be avoided by systematic vaccination and revaccination. Others, just as serious, exist in connection with the material used. Many of the laws were passed before there was any control of vaccine virus, although there was plenty of evidence that it was often faulty and that there was no way for the practising physician to recognize the good or the bad. The high bacterial content, the poor specific power, the insanitary condition of some factories were all known. Fortunately there has been a great improvement in the material since the United States Public Health and Marine Hospital Service took charge of the inspection, but there is room for still further improvement in the potency of the material. From the fact that some of the factories had to be closed on account of their bad condition, and from the misstatements of the makers, it is evident that the control should not be relaxed, but should become closer. At the same time the freshness of the virus should be more closely regulated and the factories distributed with a view to better service.

Perhaps more than anything else we need educated and trained vaccinators, and these should have positions that would enable them to carry out their functions as they should be. To make vaccination compulsory without providing educated vaccinators is as irrational as it would be to make a law requiring railroad companies to take untrained men as train dispatchers or locomotive drivers. I am not aware that this feature of the laws has ever been tested in a court. It cannot be emphasized too often that vaccination to be most successful must be a public matter, not dependent upon the good-will of the individual or the peculiarities of the private physician. In one city often visited by smallpox, I am informed that the public vaccinator refuses to vaccinate those exposed in smallpox houses, on account of a theory he holds regarding the danger of such an operation. In Germany a relatively large proportion of bad results come from the few persons vaccinated privately.

Perhaps a more efficient system of vaccination would cost more than the present method with its high smallpox morbidity. I know of no trustworthy data. For England, Mrs. Garrett Anderson has estimated that thorough vaccination would cost less than the present

system. We have not the isolation hospitals that England keeps up at great expense, but I believe that our haphazard system is proportionately more expensive. The German establishment is expensive, because skilled men and the best possible equipment are obtained. But practically nothing is spent for special hospitals, and very little for quarantine or the indirect expenses we have to meet. Moreover the investigations that come out of the government laboratories of Germany, and the same may be said of those in France and England, more than pay for the best that can be obtained, by adding to our knowledge of vaccine and its effects, and by perfecting the practical details of raising, keeping, and using lymph.

In conclusion I would make the following summary of the vaccination situation:

1. Our present method, varying much in different States and different parts of the same States, makes certain a high ratio of smallpox cases, with an unduly low protection to the individual.

2. There is nothing in the fundamental law of the land to prevent the passage of safe and efficient vaccination laws.

3. Vaccination laws should aim at a widespread protection, by vaccination and revaccination.

4. Compulsion should not be necessary, and should by no means take the place of safe and certain vaccination. Compulsion should not be practised in case of doubt as to the fitness of the subject by his physical condition or surroundings.

5. The operation should be a matter of permanent record, and a certificate from an authorized official should be proof of the vaccination of each individual.

6. The operators must be trained for their work, familiar with the vaccination laws, and bound to follow them.

7. The manufacture of vaccine must be controlled by competent experts; institutes for furnishing vaccine should be so placed as to make easier the distribution of virus.

8. The operation should be done at fixed times of year, when epidemic diseases are not most prevalent, in places appointed and equipped for the purpose; the subject should be examined after the operation at a time fixed by the regulations, or at once on suspicion of complication. Private vaccination should be permitted only under special conditions and the proper details should be exacted, with revision of the result by a competent health officer.

THE CLINICAL MANIFESTATION AND TREATMENT OF SOME FORMS OF ACUTE CARDIAC DILATATION.

By Beverley Robinson, M.D.,
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Cases of chronically dilated heart, as a result of chronic endocarditis, are very frequently met with in practice. We also encounter them in persons, particularly men, who have well-defined signs of renal disease, or of general arteriofibrosis. Among the manual laboring class, strictly speaking, we find them often as a result of arduous and continuous work; or when frequent heavy strain has occurred, large, dilated hearts are not uncommon. Of course, with an antecedent history of syphilis, or chronic alcoholism, even though the previous life-work has not been unusually trying to physical strength, the dilated heart is likely to become manifest, and that, too, at a somewhat early date, because degeneration of muscular tissue, as a result of diseased arteries and insufficient cardiac nutrition, is without doubt a notable and important factor in producing it. Again, many acute febrile diseases, especially those of infectious nature, unless their convalescent period is most carefully and a long while watched and cared for, are followed, sooner or later, by cardiac dilatation—which has come on slowly and insidiously, perhaps, but when once developed is of bad augury for the future, since it can rarely be wholly cured and only occasionally ameliorated to such an extent that life is relatively free from painful or distressing symptoms.

But my purpose in this paper is to study, not these instances with which we are all familiar, but rather those to which attention has certainly been directed by many observers, but to which still belong, as I believe, a few notes, based on observation and clinical experience, that may add something of more than passing interest and importance.

I shall first give thought and attention to the cardiac dilatation which shows itself during the course of some acute infectious diseases, such as rheumatism, pneumonia, diphtheria, or influenza. I shall then speak of acute cardiac dilatation of nervous origin, due primarily many times to the wear and tear of an anxious and working life, but in which the strain falls far more directly upon the brain and nervous system generally than upon the muscular make-up of the body. Finally, I shall speak of rapid or sudden cardiac dilatation which comes to those whose excesses in eating, or drinking, or the use of tobacco, are notable and long continued, and who are unable to bear even temporary physical strain without experiencing painful, threatening, or alarming effects which become manifest very soon or immediately.

CARDIAC DILATATION IN ACUTE INFECTIOUS DISEASES.

Acute rheumatic endocarditis in children results fatally, not by reason of the endocarditis *per se*, but because of the cardiac dilatation which follows it and is "due to a toxic action of the rheumatic poison on the cardiac muscle" (Lees). Certainly, there is much to justify this conviction if we consider the revelations of many autopsies. In some cases, no doubt, the pronounced chronic valvular disease will sufficiently explain the cardiac enlargement; but in not a few cases the endocardial changes are relatively so slight that we are not satisfied they could have been the sole and sufficient cause of the cardiac dilatation. In view of Poynton and Paine's researches, the diplococci found in the heart wall, or their toxins, are probably the really efficient factors in producing it. This dilatation "tends to diminish as the rheumatic symptoms subside, and it may increase again if the rheumatism relapses."

In many cases of rheumatism, acute dilatation of the heart is far more important in its immediate and remote results than any pericardial rub, or endocardial murmur. Indeed, it seems as though it were primarily, to a considerable degree, the direct result of the action of the rheumatic poison on the cardiac muscle itself. Its remedial treatment consists largely in the proper use of anti-rheumatic remedies, that is, internally, salicin or the salicylates, and sodium bicarbonate, and, locally, bloodletting with leeches or venesection, followed by applications of the ice-bag. In this way the heart can often be notably reduced in size, or, indeed, completely restored to its normal size, and also to its normal strength. If, however, the treatment is lessened too much, or stopped too soon, a relapse to rheumatic symptoms and particularly to cardiac dilatation is almost sure to occur. This treatment, according to Lees,[1] should be large doses of salicylates, combined with double the quantity of sodium bicarbonate to prevent salicylic acid poisoning and the "air lunger" so characteristic of it. In rheumatic children he finds "that after a short time 300 grams of sodium salicylate and 600 grams of sodium bicarbonate (in ten doses) are generally well borne, that they rarely cause vomiting, and that no depression follows." In many cases "the large doses have been continued for two or three weeks."

These facts, if duly corroborated by others, appear to me of the highest value. Locally, whenever there is engorgement or dilatation of the right ventricle, leeches should be applied; subsequently the ice-bag should be used more or less continuously. The ice-bag is of service in subduing the inflammation present and in stimulating and quieting the heart. If these methods were adopted generally

[1] Acute Visceral Inflammations, London, 1904, p. 296.

they would very greatly diminish the subsequent evil effects of acute cardiac dilatation in rheumatism and probably prevent a great amount of cardiac misery. No one who reads Dr. Lees' recent work carefully can fail to be forcibly impressed with the care and accuracy of his clinical observations. It is evident how important such findings are; it is also evident how valuable the methods of treatment, particularized and insisted upon, may later prove to be.

In *pneumonia*, especially in the cases that are serious or imminent from the point of view of the profound general toxemia or from the extent of the pulmonary obstruction, dilatation of the heart in acute form is likely to be the subject of our greatest, most immediate anxiety. In the severe toxemic cases the whole heart is involved, and no doubt the pneumococcus, or its toxin, affects the muscle in its entirety and produces relaxation, loss of tone, even degeneration, hence rapid or even sudden loss of strength in cardiac systole, and a weak, failing, rapid, or intermittent pulse. Even in these instances, and until death is very near and the respiratory centres are directly attacked by the systemic poisoning, the pulse has an appreciable volume, although it may be easily compressed and almost obliterated. The picture is very different when the right heart dilates and fails from its inability to overcome the ever-present and perhaps increased pulmonary obstruction. In these cases, it is true, the pulse is very small, and even apparently weak. But it is not because the left ventricle has lost power or is flabby and degenerated. Rather it is that the ventricle does not receive blood enough from the lungs to contract upon sufficiently and to cause an appreciable pulse wave. Under these circumstances, if we percuss the heart area we find notable increase of dulness toward the right, and sometimes in the intercostal spaces on this side, notably the third and fourth, we may detect a pulsation synchronous with the cardiac beats. Moreover, there may be marked epigastric pulsation and a considerable distention of the large veins of the neck. At this stage the pulmonic second sound, which previously had been notably accentuated, owing to increased obstructive conditions in the lungs and too rapid and forcible arterial recoil under the dependence of a struggling although powerfully acting right ventricle, has rapidly lost accentuation and become so weak as to be scarcely audible. If with this loss of pulmonic second sound, and even though the pulse remain very small, there is no increase of or very slight dyspnœa, it may be that pulmonary obstruction is diminishing, and the prognosis of the case is brighter and more hopeful. If, on the contrary, the dyspnœa is augmented and cyanosis more marked the outlook becomes, for the while at least, graver.

In such cases A. H. Smith,[2] who many years ago described, very graphically, the conditions alluded to, would insist upon the wisdom

[2] Amer. Jour. Med. Sci., 1890, p. 397, and Med. News, December 16, 1899.

of making immediate and sufficient use of the vasodilators, and especially of the nitrites. The major and urgent indication is, so to speak, to bleed from the veins into the arteries. The former are blocked up and their circulation intensely impeded by an overflux of blood; the latter receive very little blood, and the left heart is absolutely prevented from exercising its great power by reason of insufficiency of fluid in its cavity to permit of efficient action. If, under these circumstances, drop doses of nitroglycerin solution are given every fifteen minutes or every half-hour, we may at times, and very soon, see a very great and happy change for the better. The pulse increases considerably in volume, the veins in the neck become less distended, the dilatation of the right heart in part disappears, the right ventricular systole is more effective, and the pulmonic second sound is again audible.

Dr. Smith claims that in such cases the nitrites are of greater value and freer from objections than the time-honored venesection. In this I am not inclined to agree with him. On the contrary, I hold that the preliminary bloodletting, at least in moderate quantity, is essential, as a rule. I prefer, however, the application of leeches or wet cups locally to the use of the lancet: (1) Because I believe either of these methods causes less nervous upset than venesection; and (2) because despite much careful reasoning based on physiology of the circulation which declares the same amount of blood taken from a vein to be equally as beneficial as a similar amount taken locally, I still believe the contrary. I am satisfied that local bloodletting is more effective and sooner relieves symptoms of distress and oppression than venesection—the amounts of blood abstracted bring equal in the two cases.[3] I believe that the reason for this may be discovered, not in the amount of blood taken from the patient, but in the reflex started locally in the right ventricle that is transmitted to the respiratory centre, and from there becomes additionally stimulating to the heart. It is also true that the vasomotor nerves are called into action through this reflex, and afford relief through dilatation of the peripheral arteries (Lees). In this condition of pulmonary obstruction and dilated right heart we should beware of the use of digitalis in preference to the vasodilators. Rarely, if ever, should we expect benefit from digitalis; on the contrary, we find rather increase of cyanosis and distention of the veins. Keep the color florid with the use of nitroglycerin, oxygen, alcohol, and suitable diet, and, as Smith writes, we shall not be ashamed of the teachings of the sphygmograph. It is far better to have a full, gaseous pulse than a small, thready one. Smith has never yet seen a small, thready pulse become fuller and slower from the use of digitalis. It is true, however, and important to add that after the distention of the right

[3] In this opinion I regret to find that I am not in accord with Roland G. Curtin, who says: "There is, I think, very little, if any, benefit in local bleeding," Trans. Amer. Climat. Assoc., xxi, 178.

heart has been relieved by leeches or venesection, digitalis may become very serviceable in giving strength to cardiac beats when the pulse is weak, rapid, and intermittent. Digitalis is also sometimes useful, in my judgment, when the heart as a whole is affected and weakened by the toxemia of pneumonia—not merely its right auricle and ventricle because of the pulmonary obstruction.

In *diphtheria*, especially in the marked toxic forms, it not infrequently happens that sudden or very rapid death takes place. This fatal termination may come during the first days of the attack. With other signs of intense poisoning the heart impulse may increase much in rapidity and feebleness. Together with these signs there may be increasing dyspnœa, pronounced pallor of the face, and cyanosis of the lips and fingers. The face itself may partake somewhat of a dusky hue, but it is the extreme pallor, ashy at times, which excites remark and absorbs attention. The combination of symptoms is of very bad augury. There may or may not be a considerable elevation of temperature (100° to 102°). The latter point is rarely reached and often we have only 0.5 to 1 degree of elevation. In times past I have seen many such cases, and, as a rule, prior to death there were evidences in several instances of a pneumonic process in one or both lungs which had already reached the stage of solidification. Death occurs, and the pneumonia is usually verified at the autopsy. If the heart is carefully examined, what is most marked is the great distention of the right cavities with wholly cruoric clots, like currant-jelly in appearance and consistence. In other cases, these clots are half or more cruoric, the remainder of the clot being fibrinous. A similar clot formation extends well into the pulmonary artery, and both the right auricle and ventricle are filled to repletion. The clots are formed during the agony, or one or more days preceding it. Whenever the clots are largely fibrinous and possibly give some evidence of having the fibrin deposited in distinct layers, but above all when the marks of the pulmonary cusps are distinctly impressed upon the arterial clots and all the cruor is pressed out of them, we may feel quite confident that these thrombi were formed some time (one or more days) previous to the fatal termination. In such cases the heart muscle, if carefully examined microscopically, will show very few changes. The striæ are sometimes less well-marked and the muscular fibers are somewhat granular. It is rare, however, to find distinct fatty globules anywhere in its structure. Formerly it was stated, the pneumogastric nerves show no discoverable pathological changes. Latterly, however, Councilman and others have found nerve changes, although Schamshin denies them. The degeneration of the heart muscle is admitted by many. It seems, however, to White and Smith that degeneration of the vagus was indicated only in the severest type of heart cases. In this connection they write, "Undoubtedly heart failure not infrequently results from

paralysis of the cardiac nerves (or cardiac plexus), and quite independently, too, of any anatomical changes in the heart muscle."[4] Lennox Browne credits Vincent, of Paris, and P. Meyer with having found "widespread parenchymatous changes in the cardiac plexus in two patients dying of heart failure during convalescence from diphtheria, in which the heart muscle was unaffected."

Experimentally it has been shown that the healthy heart can rarely be overdistended, no matter how much its working capacity may be overtaxed. This is not true when several injurious factors are combined, nor is it true when a previous infection has existed and has surely altered the heart muscle.[5] Colbeck[6] attempts to show that all forms of dilatation indicate an absolute or relative loss of muscular tone of the organ. When in diphtheria the heart itself is somewhat dilated this dilatation affects the right cavities almost exclusively; the left auricle and ventricle are relatively empty and so far as one may determine are of normal size, and the muscular degeneration is less marked even than in the right heart. Formerly, I regarded such cases as being due not infrequently to paralysis of the heart, which came about through lack of government of the pneumogastrics, occasioned, doubtless, by changes in the nerve trunk itself which escaped our careful examinations. Today I believe it more satisfactory to make a diagnosis of acute dilatation of the heart and to attribute rapid or sudden death essentially to this condition. Of course, we have the complicating pneumonia and heart clot, but these might not have occurred, or indeed proved fatal, unless for the development of extreme and fatal heart weakness caused by the poison of diphtheria. I have seen death occur suddenly more than once in diphtheria. I have seen it in children not only, as I have said, during the acute stage of the disease, but after days had elapsed and the patient was approaching the true convalescent period. In the latter period the patient has died suddenly when there was scarcely a warning to tell us to be especially careful, except the fact that the patient had had diphtheria.

I have had one of my adult patients die suddenly when doing apparently well and sitting up in bed and playing cards with his wife. This patient had been examined by the late Austin Flint only a few hours before his sudden death, and his heart had been pronounced in good shape and no danger was anticipated. In more than one other instance I have seen very alarming conditions of heart failure. This goneness, faintness—with weak cardiac impulse and frequent, depressible, feeble, and irregular pulse—has returned twice or several times, during a period of a month or six weeks after the acute disease had terminated. With the heart weakness—the syncopal attacks, when the respiration was very

[4] Welch and Schamberg, Acute Contagious Diseases, 1905, p. 640.
[5] Med. News, January 9, 1904, p. 68.
[6] Lancet, April 9, 1904.

shallow and slow—there was a certain degree of paralysis affecting the soft palate, or some of the muscles of the thorax, or extremities. In such cases, when I have percussed and auscultated the heart, I have been quite sure that the heart was distinctly dilated, inasmuch as percussion and auscultation gave every sign of this condition. Such a condition is unquestionably remediable, not only as far as the symptoms are immediately concerned, but also in regard to their future continuance. Ultimately the heart can be completely restored and be considered as good as ever. In other cases, especially those of adults, I doubt somewhat whether we are authorized to make unqualifiedly a favorable prognosis.

At first, when attacks occur, complete bodily and mental rest is absolutely required. The patient should lie down; everything tight should be loosened or gotten rid of; smelling salts; hot-water bags to the precordium and the extremities, and five minims of tincture of strophanthus with ammonia and brandy by the mouth, or alone hypodermically, will usually bring about a rapid temporary improvement. But to secure complete cure of an acute cardiac dilatation of this origin requires months and years. Overfatigue should be strictly avoided for many months. Iron, quinine, and arsenic must be given regularly for a while to counteract the injurious effects of the secondary anemia. Strychnine, in very moderate doses, will help the heart for a time and prevent in a measure the return of syncopal tendencies. After all, however, it is country air, good nourishment, and complete rest of body and mind which will be found really most efficacious. Time[7] itself will help greatly to eliminate the remains of the toxemia from the economy; by successful war the protective forces of the body, little by little, get the ascendancy and the heart itself becomes once more normal in size and force. I have seen more than once the slight beading or small warty excrescences along the free margin of the mitral valves at autopsies in cases in which death occurred during the acute period of diphtheria. I have every reason to believe that these growths are completely resorbed later, as it is a rare circumstance to recognize clearly chronic endocarditis which we could fairly attribute to a previous attack of diphtheria.

"Pathological studies have shown that the murmurs are probably due largely to relative mitral insufficiency resulting from changes in the heart muscle or to changes in the innervation of the heart."[8] It is questionable in what number of cases acute dilatation and

[7] H. B. Anderson very properly lays stress upon the length of time after a severe acute disease that the heart should be watched and all undue strain avoided, even though no cardiac signs point to the existence of myocardial changes. "After a severe illness probably a year will be required in favorable cases before the organ has regained its former strength." (Brit. Med. Jour., October 7, 1905, p. 845.)

[8] White and Smith, Heart Complications in Diphtheria, Boston Med. and Surg. Jour., October 20, 1904, p. 423,

syncope occur. Frequently the symptoms of heart failure come on gradually; sudden death is uncommon if rational treatment is followed. It seems evident that acute dilatation of the heart is less frequent in diphtheria than in rheumatic fever. Nevertheless, in the few cases of very slow pulse there was cardiac dilatation, and in those of gallop rhythm and very frequent pulse "the heart is usually moderately dilated. In practically all of the fatal cases the heart was dilated."

Influenza is another frequent cause of rapid cardiac dilatation. Even in the early days of the disease it may occur. Not infrequently the only satisfactory explanation of the obvious great weakness of the patient is to be found in this condition. Not only is acute cardiac dilatation not infrequently met with in influenza during the first week of the disease, but subsequently, as we know, it is also encountered. The patients often get up fairly well from an acute attack, and then after a few days have a sudden relapse of weakness and prostration, and are unable to meet courageously and well the ordinary duties of daily life. When the heart is auscultated and especially when it is percussed, cardiac dilatation is sometimes clearly discovered and satisfactorily accounts for many of the patient's symptoms. Again, a patient who has had a severe attack of influenza may, after a relatively long convalescence, appear finally to be completely re-established in health. Without apparent or sufficient cause, and despite great watchfulness and care, or sometimes, it may be, following some evident and perhaps great imprudence or strain, cardiac inadequacy manifests itself and the patient feels limp, tired, incapable of exertion. Often every other organ has been examined carefully—lungs, liver, spleen, kidneys, stomach, bowels, etc., and everyone seems in fairly good shape, until the heart is very carefully considered. Not seldom the dulness to the right of the sternum is apparently about normal, and there may be no marked epigastric pulsation or venous distention in the neck; but the dulness has gone up to or beyond the vertical line passing through the left nipple, and with it the first sound of the heart is indistinct, muffled, weak, distant. The area of pulsation is feeble and diffuse. The point of greatest intensity of the cardiac systole is not readily made out, nor is the apex-beat either visible or always palpable. The pulmonic second sound has lost the accentuation, and is often extremely indistinct, and rarely almost inaudible. "These cases," writes E. G. Wood,[9] "I take to be examples of toxic degeneration of the myocardium, with resulting loss of vitality and acute dilatation." With this opinion I cordially agree.

It is in these instances, when all ordinary means have failed to re-establish the health, and when the heart action remains attenuated

[9] Amer. Med., October 17, 1903, p. 625.

and feeble, with symptoms almost of collapse at times, that an ocean voyage is sometimes most beneficial. Nothing seems to replace the absolute rest, peace, quiet from all disturbing elements, to the overwrought professional or business man, which thus can be obtained and only thus. Of course, the ocean breezes, the complete change of diet, the daily agreeable pleasant diversions on shipboard, are of untold utility to some. We must, however, distinguish at times between patients who love the sea and patients who do not; between patients who are never sea-sick and those who, perhaps, are not acutely ill, but, on the other hand, who are never entirely well. The latter class of patients is certainly far from being as promising for the benefits of an ocean voyage as the former. To these patients, as a final resort, comes the advantages resulting from the Nauheim treatment abroad, or at home. I have regarded and continue to believe that some patients—many perhaps—properly selected, get great and enduring benefit from this treatment wisely ordered. I certainly believe that there are cases of cardiac dilatation following influenza, which show a disposition to recur and become very threatening, in which Nauheim treatment has been most beneficial and in such I would now endorse it. There may be and are instances in which neither the ocean nor the subsequent Nauheim treatment can be taken, by reason of considerations of time and money. In such instances I should be inclined today, in view of what I have observed and know myself and because of observations of other competent, trustworthy clinicians, to endorse the artificial Nauheim baths and resistant movements—carefully, judiciously carried out. But this, in my judgment, is a *sine qua non*, and I say this because I believe I have seen injudicious treatment, even at the spa itself, productive of anything but what I considered desirable results. If after a few days of the bath treatment the patient is not improved, it is better to return for a while to treatment by complete rest. The after-cure treatment of Nauheim, which consists in patients being sent to the Black Forest or some portion of Switzerland, is very important. Here it would be advisable to send patients for a while, if in summer, to the Adirondacks, Catskills, or White Mountains, always bearing in mind that a moderate elevation should be selected at first, to avoid possible heart strain. James M. Anders,[19] of Philadelphia, is not convinced that the home treatment of Nauheim may be carried forward with much success, for lack of the daily care and watching of a heart specialist.

In some of these cases of dilated left ventricle following influenza, in which the heart continues rapid and irregular, and the arterial tension remains low, a prolonged course of moderate, or even small, doses of digitalis is undoubtedly useful, and I may say curative.

[19] N. Y. Med. Jour., December 3, 1904, p. 1099.

As Lees[11] has shown, in hearts merely weak digitalis is of little value, but when we have concomitant dilatation it is often most helpful and preservative.

ACUTE CARDIAC DILATATION OF NERVOUS ORIGIN.

From experiments upon animals in which the spinal cord or the vagi have been cut it appears to be shown that in warm-blooded animals digitalis acts efficiently through the nervous system, and not entirely and directly upon the muscular fiber of the heart.

Recently, I tried[12] to show how frequently dilatation of the heart occurs as a sequence of lowered nerve tone. The examples I recorded were taken from cases which had developed slowly and after a long period of various morbid symptoms. There are other examples, however, in which the nervous breakdown comes suddenly or rapidly, and the heart is the organ apparently most affected, or at all events the one which occasions the larger number of distressing symptoms. From one day to another some of these patients become conscious they have a heart, by reason of palpitation and a feeling of weakness and inability to do their usual work, which they explain to themselves with much difficulty. To the careful physician the history of their life reveals the efficient cause of their debility and cardiac distress.

Frequently it has been the result of long-continued mental work of a severe character, to which there has rarely been even a temporary cessation. Again, it has been the immediate result of some great and sudden affliction, or of collapsed business ventures after a short and losing fight to combat relative poverty and obscurity and alas, at times, greatly diminished prestige and honorable repute among one's fellows. Occasionally, it has been a statement of an unwise or ignorant physician who, by an affirmation in regard to the patient's heart, has occasioned nervous dread and apprehension for which there was primarily no real cause. I have known an insignificant and temporary systolic or diastolic murmur, revealed to a physician by merest accident or in an examination for life assurance, when told to the patient, bring all the phenomena which we could fairly assign to slight, or more advanced, cardiac dilatation. When, in such cases, absolute confidence of the patient is secured and little by little all fears banished, the remedial effects upon the heart action, force, and size have seemed to me evident and remarkable. Of course, in such instances, and as far as possible, rest, control of habits and exercise, suitable dietary, an occasional dose of ammonia and lavender, and very moderate doses of strychnine with pepsin and bismuth, have also been employed, and it might be urged that in all these agencies should be found what was curative

[11] Acute Visceral Inflammations p. 180.
[12] Amer. Jour. Med. Sci., June, 1905.

quite as much as in the mere allaying of nervous apprehension. However that may be, of one thing I am absolutely confident from repeated and long-continued observation, and it is that unless these patients are dealt with by someone who has an honest and earnest conviction as to what the real cause is of rapid cardiac failure and how it can be remedied, other means are of little or no avail. Indeed, some of those frequently employed are distinctly injurious and serve merely to accentuate and increase the physical disablement. To whip up this overtired muscle with repeated large doses of digitalis, or of caffeine, when nervous control is primarily lacking and when perhaps degeneration of the vagi or cardiac ganglia may be in an incipient stage, seems to me highly reprehensible and injurious to the patient. I am not sure either that a Nauheim treatment, no matter how intelligently employed, is at all adapted to it at first. We should wait at least a few weeks and see what rest and freedom from apprehension will accomplish; afterward no doubt the carbonic baths and regulated, very mild, resistant movements may be of much value to many patients. Always, however, we should bear in mind the limitation already referred to.

A cause of frequent aggravation of sudden, minor cases of cardiac dilatation may be found in the foolish and pernicious use of the coal-tar products. Phenacetin, antipyrine, and above all antifebrin do untold harm. We all are familiar with many pernicious, so-called headache powders. I have known what I have regarded as evident rapid cardiac dilatation with cyanosis, dyspnœa, palpitation, weak, irregular pulse thus occasioned, and it has required all my intelligence with the immediate use of friction to the extremities, rest in bed, heat to the precordium, oxygen inhalations, ammonia, and strophanthus, to restore these patients from a condition of fatal imminence.

ACUTE CARDIAC DILATATION DUE TO IRREGULAR MODE OF LIFE.

The public latterly, because of the columns of the daily press which have shown by appeal to health board statistics the rapid rise in the number of deaths due to heart disease, has become anxious to trace out the causative influences and conditions. I have endeavored to give some and to show how we should regard such cases. To speak of paralysis of the heart, or of sudden heart failure, is to say the least unsatisfactory to the well-ordered medical mind. I believe it is also becoming very true of the layman, or laywoman, and in this fact resides their commendable search after a better and more satisfactory explanation. Unquestionably, the hurry, anxieties, responsibilities, worries and cares of modern life, always increasing and more urgent; without doubt late hours and little sleep, with the constant noise and din of the large cities, are

all causes which must be controlled or eliminated, if we may hope to prevent those many nervous breakdowns, which are largely manifested by signs and symptoms of acute cardiac inadequacy depending upon dilatation. And still there are other factors to be studied and remedied. Among these we should cite the habit of too much eating and drinking; too rapid meals, meals improperly cooked and selected. Digestive difficulties, or almost sudden arrest of digestion, are brought about by stoppage of functional powers of the stomach due to strain, nervous exhaustion, supplemented or preceded by these other evident causes. How often do we see accounts of death from so-called "acute indigestion?" What does this mean? Sometimes the meal has been too abundant, too rich in varied foods with composite sauces, backed up with various wines, and no doubt what follows partakes in a measure of the exhaustion which has already touched the heart. The stomach dilates and fills with gas, due to unhealthy fermentations or the development of ptomains when the food is tainted or spoiled. Here, then, through mechanical pressure, on the one hand, and absorption of digestive poisons, on the other, are efficient causes for great and rapid weakening of a heart muscle which is already relaxed and under tone through previous causes at work. If the stomach empty itself spontaneously, or if the effort of vomiting be artificially produced, it will occasionally very greatly relieve an imminent condition. When this does not occur naturally, or the heart is so weak and fluttering that we dread to bring it about, we must depend at first upon revivifying agents like atropine, nitroglycerin, and strophanthus, which will enable the weak heart to regain at least partial control of its functions. Sometimes we utterly fail, and death, indeed, may occur before we have reached the patient and begun our active efforts in behalf of human life. In many such instances there may already be present evidences of previous arterial changes and organic heart disease; still it is very clear from the account we obtain of the history of the patient from himself or friends, that previous to the occurrence described he has always enjoyed thoroughly good health, as far as he knew. At all events, he had never suffered at all from symptoms of heart disease. It is sudden or rapid dilatation of the heart which causes the death and not the chronic condition revealed at the autopsy. This he might very well have carried for months and years without suffering, and, indeed, without knowledge of it, unless informed of its presence accidentally as it were. The great and almost insuperable difficulty is to declare certainly and positively at the autopsy what physically in the heart has been brought about within a few brief hours or days previous to death, and what belongs altogether to lesions of an older date.

Just as I have directed attention to the fatal effects at times of injudicious overeating and drinking, in like manner I would

emphasize the extreme folly of persons near or past middle life running to catch trains, going up stairs rapidly, playing active tennis, lifting heavy persons or weights beyond their powers, and thus occasioning heart strain. The acute dilatation of the heart may be accomplished in a few minutes. It may occasion immediate death, or future invalidism which is never entirely recovered from. The old saying that a man is as old as his arteries is doubtless true, but physiologically we cannot gauge accurately in every case arterial changes. We do know, however, that doing certain things involves great risks to the city man of many cares and responsibilities, who has had no previous daily healthful training which would enable him to resist successfully sudden or prolonged physical effort. Sudden strain of short duration is frequently very injurious and at times fatal. When excessive and more prolonged, the attendant risks of more marked and irremediable acute heart dilatation are in the aggregate more considerable. What is true and of great moment to almost every man and woman of middle life—and absolutely prohibitive with greatly advanced years—should also be borne in mind and guide us as regards rational advice to give young men and girls. I have seen at least one young man of slight build, who was in the contest of a running match and who suddenly collapsed from so-called heart failure. He had been in fairly good previous training, but the pace and distance were finally too much for him, and he dropped in his tracks. I cared for him until his heart got back some strength and resumed its functions sufficiently for him to sit up, and he was then carried to his home. Such a case is one of acute heart dilatation. I have been called to the ball-room where a young woman, after dancing and late hours for several successive nights, dropped exhausted and panting on the floor and was carried to her bed-room. Here, through stimulants, mustard locally, ammonia to the nostrils, dorsal decubitus, loosening and removal of corsets and all constriction from petticoats, garters, slippers, etc., there was slow recovery, and the attack of syncope was dissipated. Such faint turns must, in my judgment, usually be translated simply by calling them attacks of acute cardiac dilatation. All hospital physicians are familiar with other instances —those in which after a drunken bout, or a day of excessive strain, or heavy lifting on the part of a truckman or longshoreman, in which, also, there is a history of repeated daily drinks of whiskey, the patient has laboring, rapid, stertorous breathing, cold cyanosed nose, lips, and fingers, clammy frontal perspiration, frequent, almost imperceptible pulse, and moist mucous rales throughout the chest, showing acute pulmonary œdema.

At the same time we find notable cardiac dilatation, especially of the right heart, with distended throbbing jugulars, pronounced epigastric pulsation, and diffuse, feeble, irregular, and intermittent cardiac impulse. In these cases immediate venesection followed

by nitroglycerin by the mouth, $\frac{1}{100}$ grain every half-hour for a while, hypodermic injections of atropine, $\frac{1}{60}$ grain three or four times in twenty-four hours, and repeated dry cups all over the chest, followed by oxygen inhalations, will alone save life many times.

"Among these cases, however, are unquestionably some in which the physical signs of cardiac dilatation are impossible to determine accurately. I can well understand that their existence should be denied. In place of such a diagnosis I cannot but substitute one of loss of nerve power, either in the intracardiac ganglia or in the trunk of the vagi. To admit this would be, perhaps, also to acknowledge that the heart muscle was intact and the cavities of normal dimensions. Such a belief would be strengthened by those instances in which certain cardiac tonics, especially digitalis, are of little apparent value, perhaps, indeed, directly injurious, and rest in bed and suitable liquid diet with alcoholic stimulants appear to be most useful."[13]

The acute dilatation due merely to the use of tobacco, when excessive and long continued, is, I believe, often recognizable, although not as readily detected as in the other instances already described. The tobacco heart is often a cause of very great distress to the patient on account of heart flutterings, throbbings, irregular pulsations, coming on at times when the patient is in absolute repose, and making sleep wellnigh impossible. Such patients become specially self-centred, timorous, fearful, and anxious. Whatever else is done, tobacco must be given up, and if indulged in at all, must be taken in the mildest form and most moderate quantity. Usually, however, it is best to give it up entirely for several months, or until complete re-establishment of health has taken place. This will almost certainly occur ultimately, provided no organic heart disease already exists in advanced form.

In many cases of acute dilatation of the heart, it may be difficult to pronounce absolutely that it exists, because of the presence of pleural effusion, pulmonary solidification, or emphysema. In these cases we are often led into error, either to believe that more dilatation is present than really exists, or, on the other hand, to deny its existence when after-events prove it to be there. There is no question that light, accurate, and very careful percussion with a single finger, so well emphasized by Lees, is the surest way to avoid serious mistakes. Deep percussion with too vigorous action and several fingers, or by means of hammer and pleximeter, will often bring out resonance from other organs and conceal the correct and accurate limitations of the cardiac margins, and hence the size of the ventricles and auricles, and indeed of the entire heart.

It was stated authoritatively that during one week of June, 1906, 125 deaths occurred from heart disease in New York City. Fur-

[13] Essays on Clinical Medicine. Beverley Robinson, M.D., 1903, p. 86.

ther it was affirmed that the percentage of deaths from this cause had notably increased during the last few years. The proportion, indeed, had risen from 18 in 10,000 in 1880 to 30 in 10,000 in 1904. This steady increase of mortality may well cause reflection. In some cases death came very suddenly, in others after a period of confirmed invalidism. No doubt in many instances of both kinds the fatal occurrence would have been indefinitely postponed, if rest and relaxation from the cares of business had been taken sooner. Unfortunately, the realization of this often comes too late, when the calamity has occurred. Much of this lamentable outcome could be avoided if men in important positions would consider their vital energies as carefully as their various daily occupations. If short vacations were taken from time to time, there would be far less need of long absences from affairs to recuperate. It is only too true that what in disease has taken a long while to develop, requires an equally long time to become corrected, so as to get back one's original health and strength.

One great difficulty in estimating the risk of an ultimate breakdown proceeds from the fact of the insidious march of the physical changes which produce the disastrous results. Too often indelible marks of continued work and effort are left before a prolonged and proper vacation is taken, and then it is too late to reap much benefit from it. This holds good of the vacation of travel, or a change to the woods, an ocean voyage, or a cure at some well-known spa. The moral of all this is to take work reasonably and quietly, and it means happiness and prosperity; take it in a contrary way, and it means disease and death. The plea is for more time to eat and sleep; less hurry and worry; readiness to take needed rest when weary; more satisfaction in slower and surer gains; and the abandonment of the attempt to attain the impossible. Let us take time to apply to ourselves the lesson of 125 deaths in one week in New York City.[14]

[14] Editorial in New York Herald, June 14, 1905.

EXPERIMENTAL STUDIES OF CARDIAC MURMURS.

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In connection with experiments on the production of valvular lesions which have been carried on by one of us[1] during the past year, we have made a series of observations on the cardiac sounds with especial reference to transmission of murmurs in the dog's heart. Having studied the character of the heart sounds of the normal dog we have produced, as far as possible, the lesions commonly observed in man, each in several cases. In other experiments we have made a few observations concerning the development of functional basic murmurs. In the present communication it is our desire to refer to some of the more interesting points which have been brought out by that work which we have already done.

Methods. After etherization, the anterior part of the chest is removed, artificial respiration established, the pericardium opened, and the heart thoroughly exposed.

A special stethoscope (Fig. 1) has been devised, the bell of which is of small diameter (1 cm.), so that the sounds heard over a small organ may be better localized, and long (6.8 cm.), so that it may be placed readily upon the rather deep lying structures.

Position of the Heart. The arrangement of the chambers of the dog's heart when exposed *in situ* is somewhat different from that of the human heart. A much larger part of the anterior surface of the organ is occupied by the left ventricle, while the right auricle occupies a smaller area in the upper right-hand corner, and the tip of the appendage of the left auricle is usually visible below and adjacent to the pulmonary artery, just as it is *not*,[2] as a rule, visible in the human heart despite the orthodox illustrations.

Normal Heart Sounds. The heart sounds of the dog are closely analogous to those of the human being. The first sound over the left ventricle is duller and more muscular; over the right ventricle somewhat more flapping and valvular. With the heart exposed, it is possible to put the stethoscope directly over the aortic and pulmonic rings. The difference in the character of the second sounds, which is so often to be detected in the human being, is here

[1] MacCallum, Johns Hopkins Hosp. Bull., 1906, xvii, 260.

[2] It should be noted, however, that in some dogs an auricle which was evident *intra vitam*, disappears *postmortem*. Similar conditions may exist in man.

very striking. The second sound at the aortic orifice is of very much greater intensity than that at the pulmonic ring, of a more ringing and musical quality, while the second sound over the pulmonic valves has a deader, more wooden character. This difference is marked and characteristic, so much so as to confirm me (Thayer) in the conviction which I have often expressed, that it is sometimes possible, in the human being, to determine the origin of the second sound to which one is listening, by its character alone—a point which may be of importance in cases in which the second aortic sound is heard best to the left of the sternum.

FIG. 1.—Stethoscope with a long bell of small diameter for auscultation of the dog's heart.

Aortic and Pulmonic Stenosis. In our first experiment we produced aortic and pulmonic stenosis. This is a perfectly simple procedure, carried out by the passage of a cord about the vessel just above the valves. This may be tightened to produce any degree of stenosis desired. The production of a stenosis causes the characteristic thrill and rough murmur transmitted upward in the course of the current, just as is observed in man. The experiment differs in no essential point from that which may be performed with a rubber tube attached to a faucet.

A striking and particularly interesting point is the ease with which murmurs may be produced in the pulmonary artery. Very slight

pressure over the conus arteriosus or over the artery results in the development of a systolic thrill and murmur immediately beyond the point of pressure. The ease with which these murmurs are produced by pressure suggests immediately that a similar process may account for some of the frequent basic pulmonary murmurs which are heard in man. If systolic murmurs can be produced in man by a degree of pressure over the conus arteriosus as slight, relatively, as that necessary to bring about the same phenomenon in the dog, it is but natural to assume that the resistance offered by the chest wall alone may, in many instances, result in systolic murmurs in the pulmonary area.[3]

Aortic Insufficiency. In eight instances (experiments I, II, IV, V, VI, VII, X, XII) an aortic insufficiency was produced. In all cases a loud diastolic murmur developed at the aortic ring; this murmur sometimes replaced the second sound; sometimes the two sounds were heard in association.

Always loudest at the aortic ring, it was transmitted a short distance upward along the aorta, but best downward toward the ventricle. Over the ventricle the murmur was always much feebler, and in some instances it was inaudible at the apex. In some cases it was heard loudest on the anterior surface of the ventricle at about the middle of the line separating the right and left ventricles; in other instances, it was more distinct around toward the left, just below the pulmonic valves. Sometimes it was feebly audible through the right ventricle. The character of the murmur was exactly the same as that of the souffle of aortic insufficiency in the human being. Especially characteristic was the softness of the sound over the ventricle. The first sound over the left ventricle became dull and humming, just as in aortic insufficiency in man.

In several cases in which, after the production of extensive lesions, the ventricle became dilated and feeble, the murmur diminished greatly in intensity, sometimes disappearing wholly over the ventricle, although still faintly audible at the aortic ring.

In three of these eight cases a soft systolic murmur appeared also at the aortic valves. Marked pulsation of the peripheral vessels occurred just as in man, resulting, in some cases, in an exquisite hammer pulse, with a pistol-shot tone in the femorals.

In one case in which we were studying the basic murmurs in the heart of an animal which had been bled repeatedly and afterward infused with salt solution, there developed an exquisite aortic insufficiency with a double (systolic and diastolic) murmur at the ring and over the left ventricle which was visibly dilated. Later a typical murmur of mitral insufficiency, associated with pulsation of the

[3] In the discussion upon this communication, Dr. Janeway referred to the frequency of pulmonic systolic murmurs during forced expiration. May it not be that this phenomenon is due in part, at least, to the fact that, by the retraction of the lung, that which normally acts as a cushion between conus and chest wall is removed?

left auricle was to be made out. A sharp second sound was also audible at the aortic ring. The accompanying tracing (Fig. 2) shows, in an interesting way, the difference between the character of the femoral pulse curve before and after the development of aortic insufficiency. Unfortunately, the cannula in the left auricle had become clogged so that the pulsation of the blood in this cavity with the onset of mitral insufficiency was not recorded. The necropsy, in this case, showed that the valves were intact, although subendocardial hemorrhages in both ventricles were probably evidences of the distention to which the walls had been subjected by the artificial plethora.

The most interesting points brought out by these cases of aortic insufficiency would seem to be the intensity of the diastolic murmur at the ring and its feebleness over the aorta above and over the right and left ventricles below, a condition in every way analogous to that observed in the human heart, and wholly in accordance with the well-known fact that the murmurs of aortic insufficiency are often very difficult to hear. Especially interesting was the production of a functional aortic insufficiency from dilatation, an observation supporting entirely the conception of those observers who have insisted upon the important part which the muscle of the left ventricle plays in the closure of the aortic ring.

Mitral Stenosis. In two cases (experiments VII and IX) attempts were made to produce a mitral stenosis. It is needless to say that it was impossible to bring about changes in the valve analogous to those in a valvular stenosis in the human being. The nearest approach that was made to this was to apply a clamp at about the position of the mitral ring. The tightening of such a clamp resulted in great distention of the left auricle, rise in pulmonic pressure, and an immediate increase in the intensity of the second pulmonic sound, with a corresponding enfeeblement of the second aortic sound. In one case it was possible, at a certain point of rather moderate tightening of the clamp, to detect a slight presystolic murmur, heard best midway between the clamp and the apex, over the left ventricle. This murmur disappeared with further tightening or with relaxation of the clamp. In the other case no murmur could be produced. The first sound instead of becoming snapping and valvular, as in the characteristic valvular stenosis, became duller and more humming.

Mitral Insufficiency. In six cases mitral insufficiency was produced by tearing the valves or chordæ tendineæ with the knife-hook described elsewhere,[4] which was passed through the auricle or through the carotid (experiments II, IV, VI, X, XI, XII). The production of a mitral insufficiency resulted in the development of a blowing, rather soft, systolic murmur heard with moderate intensity

[4] MacCallum, loc. cit.

Fig. 2—(a) Tra

Exquisite to-and-fro systolic and diastolic murmur at aortic ring.

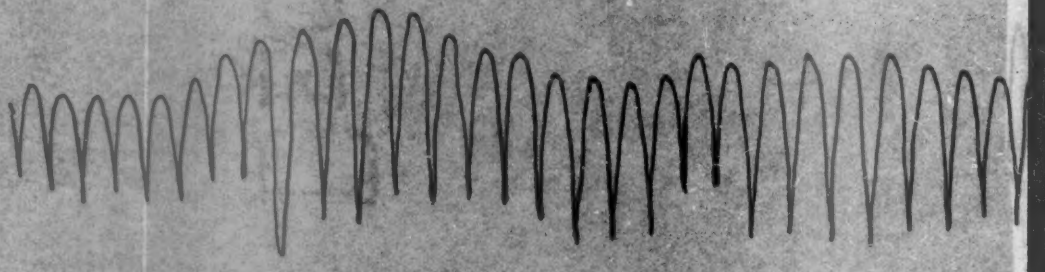


Fig. 2—(b) Same tracing later—cannula in pulmonary artery cl

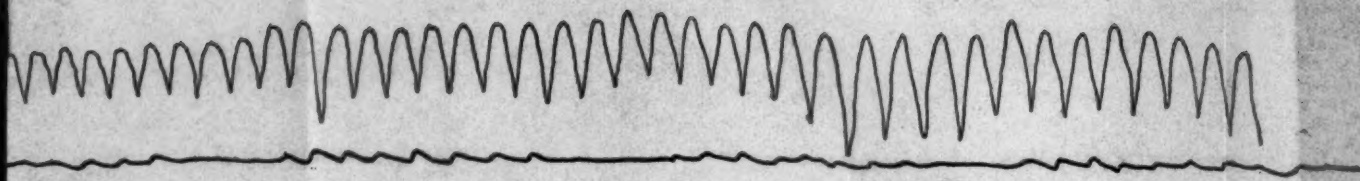
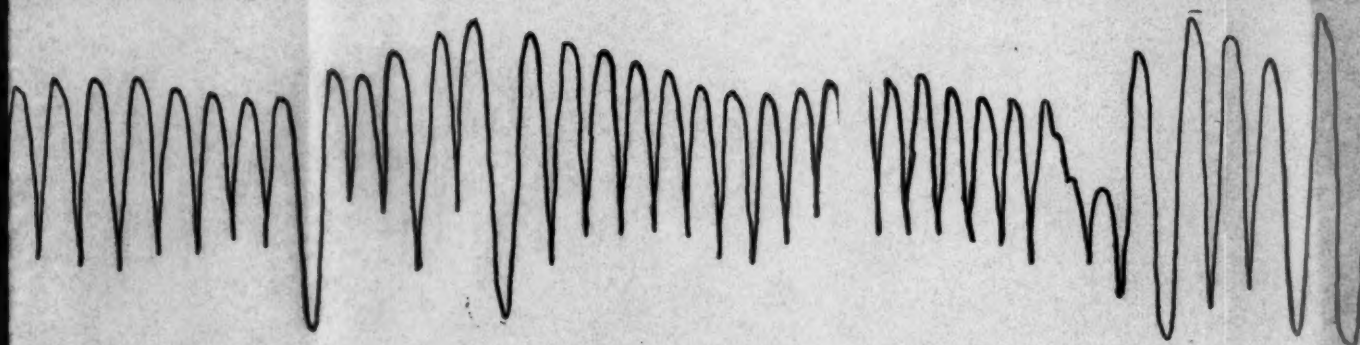


FIG. 2—(*a*) Tracing illustrating the development of aortic insufficiency from dilatation of the left ventricle after bleeding and interarterial in

stolic murmur at aortic ring.

Infusion. To-and-fro murmur at aortic rin

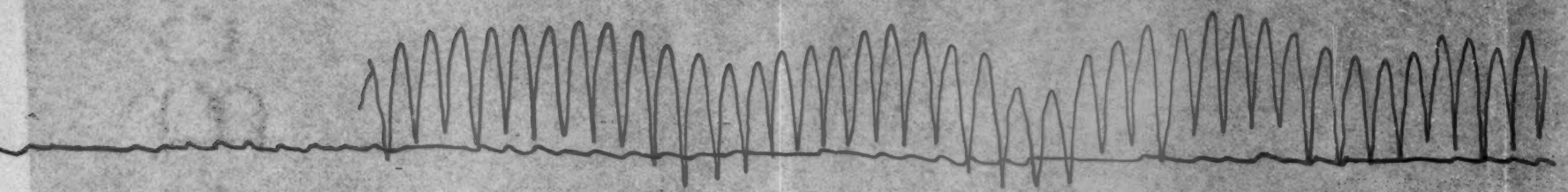


annula in pulmonary artery clogged.

FIG.

Infusion stopped.

Well-marked diastolic murmur at aortic ring and over left ventricle. Systolic murmur (feeble) at aortic ring.



rarterial infusion with large quantities of salt solution.

t aortic ring with loud second sound.

Loud systolic murmur at mitral and in left auricle.

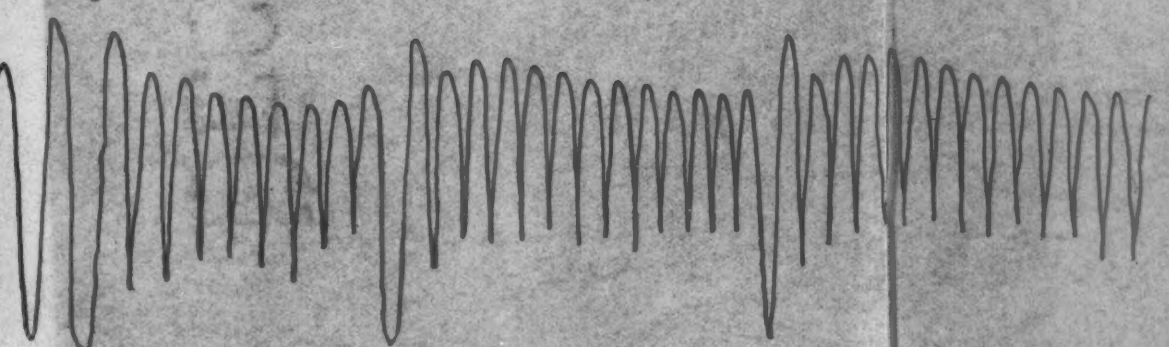


FIG. 2—(c) Same tracing later—mitral insufficiency has developed.

over the left ventricle. This murmur replaced the first sound wholly or in part; its general character was closely similar to the analogous murmur in man.

In the dog's heart, however, it is possible to place the stethoscope over the left auricle just beyond the valves at the point at which, theoretically, the murmur should be most intense. This is, indeed, the case, the murmur in most instances being very loud and associated with a thrill of great intensity. The murmur was, in some instances, transmitted to the pulmonary veins of both sides; in one case it was audible over the back of the animal. In one case, with distention of the ventricle, a characteristic murmur of mitral insufficiency developed as a result of dilatation of the ring.

It would greatly simplify the teaching of auscultation of the heart if it were possible to make demonstrations such as the foregoing before the student. For years one of us[5] has been in the habit of employing a very simple mechanism, taught him nearly twenty years ago by a valued teacher[6]—a rubber tube attached to a faucet of running water. By producing any degree of pressure upon the tube at a given spot, and by increasing or diminishing the rapidity of the flow of the fluid, many points of importance with regard to the origin and transmission of cardiac murmurs may be illustrated. Indeed, a student who is really familiar with the anatomy of the heart and surrounding organs, and with the character and theories with regard to the origin of the heart sounds, can, after such a demonstration, work out the diagnosis of the simpler valvular lesions with little assistance. The very simplicity of the demonstration sometimes leads the student to doubt its complete applicability to conditions existing in the living animal. For years I[7] have been in the habit of teaching students that the murmur of mitral insufficiency is doubtless loudest at the mitral ring and just beyond this point in the left auricle—that its intensity at this point is probably great—that there is probably also a well-marked thrill over the left auricle—that the deep position, however, of the left auricle and the mitral ring render these conditions undemonstrable—that the murmur is audible at the apex alone because this is the only point at which it is possible to approach the left ventricle—that the murmur of mitral insufficiency is not, as a rule, very intense because, as in the experiment with the rubber tube, the murmur and thrill diminish rapidly as one passes above the point of constriction. But obvious as such an explanation may seem, it is often difficult to impress the student. What a luminous demonstration it would be if one could supplement the experience with running water with experimentally produced lesions as above described—if it were possible for the student to put his finger and his stethoscope on the left auricle as well as on the apex of the heart.

[5] Thayer. [6] Dr. W. W. Gannett, of Boston. [7] Thayer.

There is no reason why such demonstrations could not be made to small sections of students. We are daily inculcating in our students a wholesome skepticism with regard to all things that are insusceptible of proof; and wherever palpable confirmation of our theoretical explanations of morbid phenomena can be offered, we should not fail to produce it.

In one case of dilated heart a characteristic murmur of mitral insufficiency developed as the result of a dilatation of the ring.

Protodiastolic Gallop Rhythm and Murmur. In one instance (experiment IX) an interesting phenomenon was observed. This experiment was started with the idea of observing whether, with aortic insufficiency, the pressure in the left auricle was increased without coincident mitral insufficiency. Cannulæ were inserted into the left femoral artery, into the appendage of the left auricle, and into the peripheral end of a pulmonary artery. By so doing the heart was rotated over toward the right, while the left auricle was held rather tensely in position by the cannula in the auricular appendage. This appeared to have the effect of placing the heart in a position in which it was, in a way, suspended by the left auricle. There then became audible over the left auricle and just below the valves a first, a second, and then, after a momentary pause, a third sound—a diastolic rumble in every way similar to the early diastolic murmur heard in some cases of mitral stenosis. When the heart became more rapid this rumble extended into presystole, simulating, closely, a mitral stenotic murmur. There was no mitral regurgitation. Gradually the murmur disappeared and one heard only a thud, which became clearer with the decreasing rate of the heart's action. One was able to observe the systole of the ventricle immediately followed by the second sound, which occurred while the ventricle was still in a state of contraction. Then followed the sudden dilatation of the ventricle which occurred *abruptly, with a distinct shock, having altogether the appearance of an active muscular process.* Synchronously with this shock occurred the third sound. This thud was clearly analogous in time (*a*) to the so-called *opening-snap* heard in mitral stenosis and ascribed to the sudden tension of the thickened mitral valves with the beginning of diastole. Its character, however, was precisely that of (*b*) the sound in protodiastolic gallop rhythm heard under so many circumstances, especially in nephritis, dilated heart, adherent pericardium, etc., and ascribed variously to the impact of the auricular blood upon a ventricle which has lost its elasticity (Potain),[8] or to an active muscular dilatation of the ventricle (Brauer).[9]

The case is interesting because we were able to *see*, so to speak, the association of this sound with a definite moment in the heart's

[8] Clinique médicale de la Charité, 8°, Paris, 1894, 27.
[9] Verhandl. d. XXI Cong. f. inn. Med., Wiesbaden, 1904, 187.

cycle—that is, the shock of what appeared to be an active diastole, and the association of a murmur with conditions which seemed to suggest the suction of blood into the ventricle.

It may be well here to mention the fact that the presence of a third sound at just this period of the heart's cycle is not infrequent in the apparently normal heart, especially in children. The sound is sometimes a dull thud, sometimes merely a hum, and occurs shortly after the second sound, that is, at the beginning of ventricular diastole. Sometimes it is followed by the faintest suggestion of an echo, so that I[10] have long been in the habit of maintaining that the entrance of blood from the auricle into the ventricle through a normal orifice is associated in some instances with a slightly audible sound.

Basic Systolic Murmurs. In four cases (experiments III, VIII, IX, XI) we have studied the effect of changes in the heart's action on the sounds at the arterial orifices. The question here is too complicated to justify elaborate discussion on the basis of our few experiments, but a brief summary of what we have observed may be of interest.

A. *Aortic Murmurs.*

1. Systolic murmurs at the aortic ring were never found in the normal heart.

2. Variations in arterial pressure produced by nitroglycerin or adrenalin did not result in their appearance.

3. These murmurs appeared in conditions of rather low pressure.

4. In two instances (III and XI) they followed bleeding alone. In such cases the administration of adrenalin with a rise in pressure caused the disappearance of the murmur.

5. Systolic aortic murmurs were especially frequent after infusion of salt solution following bleeding.

6. In general, aortic systolic murmurs were especially frequent after bleeding followed by infusion, in association with what appeared to be rather abrupt action of the ventricle and rather large excursions of the pulse. They sometimes followed hemorrhage alone. They never appeared as the result of modifications in pressure following the administration of nitroglycerin or adrenalin.

B. *Pulmonic Murmurs.*

1. As has been already noted, pulmonary systolic murmurs may be produced with great ease by slight pressure on the conus arteriosus or the pulmonary artery.

2. In two instances a pulmonary systolic murmur developed after considerable hemorrhage.

3. In one instance with a low general pressure following nitroglycerin, a pulmonary systolic murmur developed. The adminis-

[10] Thayer.

tration of adrenalin and nitroglycerin had, however, but little effect in modifying the pressure in the pulmonary artery.

4. The administration of adrenalin resulted in an increase in systolic pulmonary murmurs when present, during the first strong beats which followed, but during the period of very high pressure occurring in the general circulation, the pulmonary murmurs as well as murmurs at the aortic area, tended to diminish, returning, however, again, if present before, with a fall of pressure at a period when aortic murmurs still remained absent.

5. Infusion of salt solution resulted commonly in the development of systolic pulmonary murmurs.

6. In a general way, conditions which resulted in especially abrupt action of the right ventricle with a large excursion of the pulse wave in the pulmonary artery seemed to favor the development of systolic murmurs at the pulmonary orifice, especially if there had been a preceding hemorrhage followed by infusion of salt solution.

Murmurs were produced more readily in the pulmonary artery than in the aorta, notwithstanding the very slight variations in pressure which occur in the lesser circulation. This was probably due, at least in part, to the fact that with a more or less indistensible ring, the pulmonary artery beyond is much less resistant than the aorta, and capable of greater dilatation with ventricular contractions of moderate force, thus producing, just beyond the pulmonary ring, those conditions favorable to the development of fluid veins, and consequently a thrill and murmur.

In general, our observations seem to show that a change in the character of the circulating blood, such as that which results in the replacing of a considerable quantity of blood by salt solution (diminished viscosity?)is extremely favorable to the development of systolic murmurs at the base.

In conclusion, it may not be amiss to repeat that we have been strongly impressed, during these studies, with the feeling that where auscultation is taught in small sections, several exercises in the study of experimental cardiac murmurs in the dog would do more toward making clear in the mind of the student the essential facts, without which rational diagnosis of cardiac lesions is impossible, than any other method of instruction with which we are familiar.

ANEURYSM OF THE ARCH OF THE AORTA: RUPTURE INTO THE SUPERIOR VENA CAVA.[1]

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The patient the subject of this report was admitted to St. Mary's Hospital, Philadelphia, October 19, 1905. He was an Irishman, aged fifty-four years, by occupation a weaver.

Previous History. He had typhoid fever forty years ago and rheumatism twenty-four years ago. He denies syphilis. His wife died a number of years ago, never having had any miscarriages. He drinks considerable whiskey, and was drunk two weeks before his admission to the hospital. His parents are dead, of unknown cause. He has five brothers and sisters living and well.

Present Illness. He was perfectly well until October 17, 1905 (two days before admission). At that time he noticed a sudden swelling of the face and arms, accompanied by cough and dyspnœa, which prevented him from lying down in bed. He had no pain. Before this attack he worked every day and never noticed any dyspnœa, œdema, or palpitation.

Examination on Admission. The patient suffers from orthopnœa. His face, both arms, neck, and upper chest, are swollen to twice their normal size, and are œdematous and markedly cyanosed. All of the superficial veins are greatly enlarged; some are as large as a crow-quill. The external jugular vein on the left side is dilated to the size of the index finger, and a branch of this vein crosses the superior part of the sternum and anastomoses with the mammary veins. The veins at the margin of the ribs form great varices; in places the chest is almost black from the number and size of these veins. The superficial veins over the left abdominal wall are slightly increased in size. The hands, the legs, and the genitals are not swollen. There is slight œdema of the abdominal wall. The heart dulness, as shown in Fig. 1 *A*, is about normal in size. The apex-beat is difficult to palpate and is quite irregular. The sounds at the aortic cartilage are clear and the second is accentuated. There is an indistinct "crunch" at the xiphoid. At the apex the first sound is weak and valvular and there is a very indistinct systolic murmur. No abnormal dulness is made out over the sternum. There were no murmurs in the vessels or at the root of the neck. The systolic blood pressure in the left arm is 189, in the right arm 160; diastolic pressure in the left arm 160, in the right arm 120. There is a slightly dull note at the apex of the right lung. There are no other abnormal percussion sounds. The breath sounds are normal throughout. There is no abnormality in the abdomen; neither the liver nor spleen can be palpated.

[1] Read at the meeting of the Association of American Physicians, Washington, D. C., May 15 and 16, 1906.

October 22. Patient complains of great dyspnœa and troublesome cough. The cyanosis and œdema of the upper half of the body have increased. There is marked dulness on percussion under the first piece of the sternum, as shown in Fig. 1 *A*. No pulsation can be felt over this area or in the suprasternal notch. There is a slight systolic murmur over the dull area. Auscultation of the trachea does not develop compression of that organ. At the apex of the left lung the expiration is slightly prolonged. Tracheal tug cannot be developed. There is no pulsation over the area of dulness. A radiogram was taken and did *not* show the presence of an aneurysm.[2]

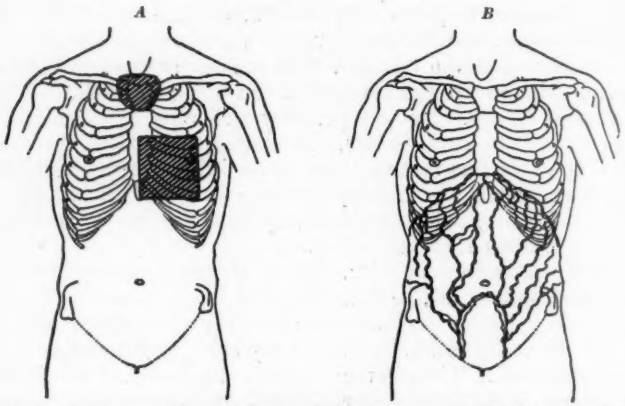

FIG. 1.—*A*. The area of heart dulness under the sternum. *B*. The distention of the abdominal veins.

23*d*. Patient has great distress upon swallowing, on account of the dyspnœa it causes.

25*th*. Laryngological examination shows venous engorgement of the mucous membrane, but no signs of pressure.

26*th*. Dulness over the first piece of the sternum still persists. There is no visible or palpable pulsation. At the junction of the first and second pieces of the sternum there is a marked to-and-fro murmur with a very sharp second sound. Pressure over the sternum causes great distress in breathing.

31*st*. The apex of the heart is far to the left of the nipple line. There are signs of pleural effusion in both chests. About one pint of bloody liquid was removed from the right chest. A marked dermatitis has developed in both arms.

November 12. The veins over the chest are more distended. No dulness can be made out over the manubrium, but the marked

[2] This, of course, was because of the small size of the aneurysm, immediately under the sternum.

double murmur with a sharp second sound can be heard. It can also be heard in the back. There is marked distention of the abdominal veins.

26*th*. The abdominal veins are greatly enlarged (Fig. 1 *B*). These veins anastomose with the greatly distended veins of the chest. There is no marked enlargement of the veins on the posterior part of the chest. The dulness over the sternum is marked. No thrill or pulsation can be felt. The same murmur, double in character, can be heard, with an accentuated second sound. There is no murmur in the veins of the neck.

The patient died suddenly on the morning of October 27. There were slight rises of temperature during the course of the disease. The urine was normal. The hemoglobin was diminished, but there were no other blood changes.

Autopsy. The body is that of a middle-aged man. There is no œdema of the extremities. The superficial veins of the chest and abdomen are tortuous and considerably dilated. On removing the sternum the azygos veins are seen to be greatly distended. The right pleural cavity contains about 950 c.c. of cloudy amber fluid. The parietal veins are dilated. The left pleural cavity contains about 135 c.c. of cloudy amber fluid. The parietal veins are distended. At the apex of the right lung are a few healed scars; scattered throughout the upper lobe are numerous white areas, about the size of a millet-seed, which on section are seen to be miliary tubercles. In two or three places these tubercles are massed together and are beginning to caseate. The left lung is smaller than its fellow. The surface is of a very dark purple color. The lung is nowhere crepitant except at the anterior margin. The cut surface presents a firm, marbled appearance; the alveoli appear to be obliterated; on compressing the lung a white, purulent fluid exudes. At the apex there are several old, healed scars; there is no evidence of acute tuberculous involvement. A section of the lung sinks in water. The pericardial cavity contains about 50 c.c. of turbid amber fluid. The surfaces are smooth.

Heart and Aortic Arch. The heart lies in its usual position. It extends on the right about 5 cm. to the right of the median line. The displacement to the right is due to the immense effusion in the left pleural cavity. Just beneath the sternum, on a level with the third rib, extending from the second rib to the third interspace, there is an indefinite mass bound about by adhesions, but not attached to the sternum. The heart itself is approximately normal in size. The muscle is dark-red in color and somewhat decreased in consistency. The walls are thinner than normal: the right ventricle averages 1 mm. in thickness, the left ventricle about 10 mm.; the cavity is about normal in size. The leaflets of the tricuspid, pulmonary, and mitral valves are thin, delicate, and apparently normal. Two leaflets of the aortic valve contain a calcareous nodule at their

bases which protrude into the sinus of Valsalva. They measure about 3 mm. in diameter; otherwise, these leaflets are thin and delicate. All the valves are apparently functionally intact. The circumference of the aortic ring is 7 cm. Scattered over the various portions of the arch, as well as of the thoracic aorta, are numerous atheromatous plaques, measuring from 2 to 17 cm. in their greatest diameter; none of them are actually calcareous. At a distance of 5.5 cm. from the aortic ring is a sacculated dilatation of the ascending

FIG. 2.—Exterior of the aneurysm, showing rupture into the vena cava; the vena cava laid open. 1. Aorta, exterior surface. 2. Adventitious sac filled with clot. 3. Vena cava laid open. 4. Opening from the sac into the vena cava.

part of the arch of the aorta, measuring 3.5 cm. in diameter (Fig. 2). This sac, which protrudes from the aorta on the right and slightly posterior, measures 3 cm. in depth, and is narrower than the greatest diameter of the aorta itself. The vena cava is constricted near the centre, where there is a small aperture about 7 mm. in diameter, and with a smooth edge, so that there is direct communication between the ascending aorta and the superior vena cava (Fig. 3). The aneurysmal sac distends the aorta at the origin of the innominate,

but the aorta is apparently normal at the origin of the left carotid artery. The aneurysmal sac has ruptured downward and forward, and has formed an adventitious sac between the aorta and the superior cava. This adventitious sac has for its walls the ruptured aorta, the connective tissue surrounding the vessel, the superior cava, and the pulmonary artery. It measures from above downward 6.5 cm., and is approximately 3.5 cm. in diameter. It has compressed the superior cava 3 cm. above its entrance into the auricle, and has ruptured into the cava at this point. The opening

FIG. 3.—Interior of the aorta, showing the aneurysm. 1. Innominate artery. 2. Left carotid artery. 3. Left subclavian artery. 4. Aorta. 5. Aortic valves. 6. Aneurysm with clot at the bottom.

into the cava is about 7 mm. in diameter and is elliptical in outline, the long axis of the ellipse being in the direction of the vessel. The true aneurysmal sac in the aorta is entirely free from clot, but the adventitious sac is filled with a firmly organized coagulum. The blood has forced its way between the adventitious sac wall and the organized clot. It is seen from this that the actual rupture of the true aneurysmal sac must have occurred at a time antedating the symptoms, but the rupture from the adventitious sac into the cava doubtless occurred at the onset of the symptoms.

The liver weighs 1150 grams and measures 20 x 17 x 6 cm. The

surface is smooth, free from adhesions, and of a dark purplish color. Near the falciform ligament on the surface of the left lobe is a hard, calcareous nodule, about 5 mm. in diameter. The cut surface is brownish red in color. The central veins are clearly seen and are surrounded by a paler area of a light-brown color. Glisson's capsule is not increased. The consistency of the organ is diminished and the organ may be readily torn. The gall-bladder is normal. The spleen weighs 50 grams and measures 6 x 7 cm. The bloodvessels project above the surrounding pulp. There is a slight increase in the trabeculæ.

The right kidney weighs 105 grams and measures 10 x 6 x 2.5 cm. The left kidney weighs 95 grams and measures 6 x 2.5 cm. Their capsules strip with difficulty. The external surfaces are of a dark purplish color. On section the cortex averages 7 mm. in thickness. The consistency of the organs is increased. The Malpighian bodies are not visible.

The pancreas, stomach, and intestines are apparently normal. There is moderate atheroma, with a few calcareous plates in the abdominal aorta. The walls of the urinary bladder are somewhat thickened and congested.

Histological Examination. Heart. The epicardium is wanting. The endocardium is apparently normal. Interstitial connective tissue is not increased. Fragmentation of the muscle fibers is very marked in some places, less so elsewhere. Polar pigmentation is very marked, every fiber giving evidence of it. The capillaries are slightly thickened. The striæ of the muscle fibers are preserved.

Liver. The external capsule and the capsule of Glisson are apparently of normal thickness. All the capillaries are more or less engorged with blood cells, but especially the intralobular veins. The bile ducts are normal. In many places the columns of liver cells are farther apart than usual, and in spaces thus left red blood corpuscles are to be seen. Many of the hepatic cells are filled with a brown pigment. Those surrounding the terminals of the hepatic vein are especially rich in pigment granules, while the cells in the periphery are often quite free of them. The nuclei of the cells take a deep-blue color with hematoxylin.

The rarity of this rupture of an aortic aneurysm into the superior cava may be judged by some figures by Kelynack.[3] He reports 4593 cases of aneurysm of the arch of the aorta with rupture in thirty-two cases, or 6.9 per cent. Of these, one was into the superior cava. Therefore, one would have to see in the neighborhood of 5000 aneurysms before observing a rupture into the superior cava Two cases similar to the one here reported have been presented to this Association (Pepper and Griffith[4] in 1890, and Stengel[5] in

[3] Lancet, 1897, ii, 193.
[4] Trans. Assoc. Amer. Phys., 1890, v, 45.
[5] Ibid., 1900, xv, 532.

1900). Thus three out of five of reported American cases have been reported before this Association.

Pepper and Griffith collected all the cases of rupture into the vena cava which had been reported previously, in all, twenty-nine cases. I am now able to add seven more cases, those reported by Ord,[6] Mercudino,[7] Bruce,[8] Stengel, Rendee,[9] Leyden,[10] and my own, making a total of thirty-six cases. Careful review of these thirty-six cases leads to a confirmation of the thorough and exhaustive analysis which Pepper and Griffith made of their cases sixteen years ago. The chief points were: The sudden cyanosis, œdema, and distention of the veins of the face, neck, arms, and upper half of the trunk. The picture is so striking that once seen it can never be forgotten. The picture is almost grotesque, so great is the disparity in size and appearance between the upper and the lower halves of the body. It was my fortune to see during life the case reported by Pepper and Griffith, and while the condition had not again been brought to my mind, I was able at once to recognize my case as one of this character when first seen.

The murmur so accurately described by Pepper and Griffith, the continued high-pitched murmur with increase during systole and general decrease in intensity during the diastole, has been present in sixteen of the thirty-six cases reported. A to-and-fro murmur is described eight times, systolic six times, diastolic once, and is not mentioned five times. The symptoms and sings of an aneurysm in the chest, of course, make the diagnosis much more easy and certain.

Thirteen of the thirty-six patients gave the history of being entirely well before the symptoms of rupture; but at autopsy twenty-nine of the cases were shown to have tumors as large or larger than an orange, and therefore were probably susceptible of a diagnosis of aneurysm at or before the rupture, had the point been given attention, —although, as Osler has pointed out, there are cases of aneurysm with symptoms but without physical signs, and aneurysms with signs but without symptoms. All of the symptoms and physical signs of rupture into the cava may, however, be simulated by pressure upon the cava, as proved by the following case reported by Salomon.[11]

A man was admitted to the Hospital Laënnec, April 24, 1903. On a certain night this individual was heard making noises in his room. No attention was paid at the time. In a few hours he was found unconscious and taken to the hospital. He was comatose. There was an intense cyanosis of the face, neck, and arms. There was little œdema. There was a continuous murmur over the base of the

[6] Brit. Med. Jour., 1891, i, 407; Trans. Path. Soc. London, 1891, xlii, p. 71.
[7] Gaz. Med. di Torino, 1893, xlii, 517.
[8] Edin. Med. Jour., 1985, xl, 896.
[9] Sem. méd., 1900, xx, 151.
[10] Deut. med. Woch., 1904, i, 601.
[11] Bull. et mém. Soc. anat. de Paris, 1903, vi, 463.

heart, with intensification during systole and diastole. There were signs of aneurysm of the arch of the aorta. On account of the peculiar cyanosis and rapid onset a diagnosis of aneurysm rupturing into the cava was made. At the autopsy an aneurysm of the ascending portion of the arch was found. The right side of the sac was in connection with the vena cava superior. Careful examination of the vena cava and of the aneurysmal sac failed to show any communication between the two. There was no thrombosis in the vena cava.

The murmur described is simulated by the murmur caused by a rupture between an aneurysm and the pulmonary artery, as proved by cases reported by Clarke[12] and Kaufmann,[13] but in these cases there is not the characteristic cyanosis of the face, head, and chest. Cases are reported of a tumor making gradual pressure on the vena cava in which nearly the same physical signs exist, excepting the murmur. In his case, too, Goldflam[14] says the symptoms came on slowly.

The diagnostic signs, then, of rupture of an aneurysm into the superior cava are: (1) A sudden cyanosis, œdema, and dilatation of the veins of the face, head, neck, arms, and chest. (2) A peculiar, continued, high-pitched murmur, present in about half the cases. (3) The physical signs of an aneurysm of the aorta. A very probable diagnosis of the condition may be made on the first sign alone.

A STUDY OF THE DIFFERENT FORMS OF ALBUMIN OCCURRING IN THE URINE.

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Strictly and correctly speaking the term albuminuria may be limited by some to the excretion of albumins in the urine through the renal tissues; but if the term is considered as applied almost universally it relates to the finding of an albumin in the urine excreted from the bladder. We have accepted the second conception as the basis for this article, which deals with over 5000 examinations of specimens, many of which were sent to the laboratory with the statement that albuminuria was present and with the request to interpret this condition. It has been found that the large majority

[12] Brit. Med. Journ., 1900, ii, 1701.
[13] Wien. klin. Woch., 1905, xviii, 1004.
[14] Méd. mod., 1892, iii., 416.

of medical men recognize but one type of albuminuria—any positive reaction for albumin meaning serum-albuminuria, a view which is erroneous.

ALBUMIN BODIES COMMONLY FOUND IN URINE. If one studies this subject it is found that albumin bodies of endogenous origin which may occur in urine are numerous, including serum-albumin, serum-globulin, fibrinogen, fibrin, nucleo-albumin, nucleo-proteid, mucin, Bence Jones' albumin ("albumose") and the derivatives of albumin, digestive albumose, and true peptone.

In a recent article[1] we have gone at length into the classification of the albumin bodies which might, theoretically, occur in the urine, the albumin bodies which commonly occur in the urine, and the reasons for releasing from consideration certain of these bodies; we have emphasized four of them which should be borne in mind for common-sense reasons—serum-albumin, serum-globulin, nucleo-albumin, Bence Jones' albumin (albumose); and, furthermore, we have given reasons for adopting the following simple methods of differentiation:

The specimens of urine were subjected to four distinct tests: (*a*) Heat and acetic acid for the presence of an albumin body; (*b*) cold acetic acid with diluted urine to prove the presence of nucleo-albumin or mucin; (*c*) heat and acetic acid, after salting with saturated aqueous sodium chloride solution, thus excluding nucleo-albumin and in many instances bringing out a serum-albumin reaction not detected by the first test, on account of the poor neutral-salt content of the urine; (*d*) the test given for serum-globulin.

Out of 5330 specimens, 4068 (76.5 per cent.) showed reactions for albumin by heat and acid, (*a*) or by salting and heat and acid, (*c*) or by both; and it is upon 3089 of these specimens, in which the albumin bodies were carefully separated, that the percentages of different types are based.

METHODS FOR SEPARATING AND RECOGNIZING ALBUMINS.[2]

(*a*) Test-tube two-thirds full of urine:

Heat upper one-third of urine. Cloudiness may be—serum-albumin, nucleo-albumin, serum-globulin: On addition of 2 to 5 drops of 50 per cent. acetic acid and second heating—increased cloud or lessened cloud persisting.

Albumose (Bence Jones), phosphates, carbonates: On addition of 2 to 5 drops of 50 per cent. acetic acid and second heating—disappearance of cloud or partial clearing.

If the reaction is faint ("faint trace")—probably serum-albumin, nucleo-albumin, or both.

[1] T. W. Hastings, Albuminuria, Medical Record, July 7, 1906, p. 13.
[2] Hastings, Medical Record, July 7, 1906.

(*b*) The presence of nucleo-albumin is tested for by diluting 3 to 5 c.c. of urine with five to six times its volume of distilled water, adding to one-half of this diluted urine 1 to 2 c.c. of 50 per cent. acetic acid cold, not heating; a diffuse cloudiness in the acidulated one-half is probably nucleo-albumin (may be mucin, but mucin will not respond to the first heat and acetic acid test).

(*c*) Nucleo-albumin is not precipitated by heat and acid in highly "salted" urines, and, therefore, saturated aqueous solution (30 per cent.) of sodium chloride is used to prove the presence of serum-albumin.

To the urine add one-fifth volume of saturated sodium chloride solution, heat the upper one-third, add 2 to 5 drops of 50 per cent. acetic acid, and heat a second time; a persistent cloud is serum-albumin (may be with serum-globulin).

If a massive reaction, there is usually serum-albumin with serum-globulin; may be Bence Jones' albumin ("albumose") or serum-albumin alone or with fibrinogen.

To separate serum-globulin and albumose (Bence Jones' albumin), to the urine add one-fifth volume of saturated sodium chloride solution and 2 to 5 drops of 50 per cent. acetic acid, with or without heating. Cloudiness may be serum-globulin, albumose (Bence Jones' albumin), or, rarely, serum-albumin alone.

Heat the upper one-third. A heavy cloud followed by partial clearing suggests albumose (Bence-Jones). A persisting cloud is serum-globulin or serum-albumin, or both.

Boil the entire tube and filter. A heavy cloud reappearing in the filtrate on cooling is albumose (Bence-Jones' albumin). A faint reaction on cooling, due to deutero-albumose, often appears; this has practically no clinical value.

(*d*) For serum-globulin:

To a test-tube of distilled water add urine drop by drop to 8 to 10 drops, no heating. A cloud (cold) means serum-globulin, which clears after addition of 2 to 5 drops of 50 per cent. acetic acid (cold).

It is sufficient to state that such methods depend upon the properties of the different albumins, whereby they react differently to heat and to acids in solution, free from or possessing a low content of neutral salts, and containing large amounts of neutral salts, properties well known to physiological chemists and not sufficiently noted by the physician. Practical illustration of the results obtained by such methods is seen in these urine examinations in five cases of lobar pneumonia. (See Table I.)

There is only one chance for confusion, that of mucin with nucleo-albumin, since both react in dilute solutions poor in neutral salts to an excess of acetic acid in the cold. Mucin, however, does not react to heat and acetic acid as does nucleo-albumin in urines ordinarily; and when the first test without salting is positive and the second test with salting is negative, the nucleo-albumin is cer-

tainly present and may react in dilute solution after the addition of cold acetic acid.

TABLE I.

PNEUMONIA CASES.

	Test *a*.	Test *b*.	Test *c*.	Test *d*.	NaCl per cent.	Amt. c.c.	Sp.gr.	Casts.
CASE I.								
Jan. 24	+	0	+++	0	0.68	....	1016	0
25	+	0	++	0	0.5	....	1020	H+G
26	+	0	+	0	1.2	400	1018	H+G
27	+	+	++	0	0.5	800	1027	H
29	+++	0	+++	+	0.6	1250	1022	H+G
30	+	0	++	0	0.5	800	1025	H+G
31	+	0	++	0	0.45	420	1026	H
CASE II.								
Jan. 25	+	0	++	+	0.85	1600	1015	H+G
26	+	+	0	0	1.05	2400	1010	0
27	+	0	+	0	0.75	2000	1005	0
29	+	0	+	0	0.75	2450	1006	0
30	+	0	+	0	1.45	1300	1015	0
Feb. 1	0	0	0	0	0.9	2500	1010	0
4	+	0	+	0	0.48	1300	1016	0
CASE III.								
Feb. 15	++	+	+++	0	0.3	800	1016	H+G
16	++	+	+++	0	0.2	1000	1016	H+G
17	+	+	++	0	0.5	400	1018	H+G
19	++	+	++	0	....	500	1014	H+G
20	+	+	++	0	0.2	600	1014	H
21	++	+	+++	0	0.3	1080	1014	H+G
CASE IV.								
Jan. 24	++	0	+++	+	0.63	1380	1018	H+G
26	+	+	+	0	0.85	1000	1016	H+G+E
27	+	+	+++	+	0.15	1800	1014	H+G
29	+	0	++	0	0.15	750	1012	H
30	+	0	+	0	0.2	1300	1015	H
Feb. 1	+	0	++	0	0.25	2400	1016	—
4	+	0	+	0	0.62	700	1020	H
6	++	0	++	0	0.74	1000	1018	H+G
7	++	0	++	+	0.8	900	1020	H+G
CASE V.								
Feb. 3	+	0	+	0	0.13	400	1025	0
6	+	+	0	0	0.7	560	1022	0
8	+	+	++	0	0.34	800	1026	0
9	+	++	+	0	0.34	520	1022	0
10	+	++	0	0	0.5	520	1026	0
12	0	0	0	0	0.95	....	1015	0
15	+	+	0	0	0.75	980	1015	0
17	++	++	+	0	0.55	1180	1014	H
19	+	+	+	0	0.85	2000	1014	H
20	+	+	+	0	0.95	1200	1016	H
24	+	+	0	0	1.00	....	1020	0

\+ = faint reaction.
++ = marked reaction.
+++ = massive reaction.

H = hyaline casts.
G = granular casts.
E = epithelial casts.

Among the figures following there is no question concerning those for "nucleo-albumin" alone but under those for "nucleo-albumin and serum-albumin" the nucleo-albumin reaction (cold) may have been due in some instances to mucin, and yet we class the reactions as for nucleo-albumin, since mucin is very rarely present in sufficient amount to respond to any test when small amounts of urine are used, excepting in gross infectious conditions usually below the ureters, and in infectious conditions one finds nucleo-albumin as well as mucin, serum-albumin, and possibly serum-globulin. According to Dr. Hoobler's analyses of 1988 specimens, giving one test for albumin, mucin occurred in 349 (17.5 per cent.); but when one uses the heat and acetic acid test mucin does not respond, and it need not, therefore, be considered from a practical

standpoint. In three cases only have we been able to isolate mucin and recognize it as such by splitting with mineral acids and obtaining a reducing body from the twenty-four-hour urine output.

As mentioned in the former article referred to, serum-globulin need not be considered apart from serum-albumin, since in these 3089 specimens of albuminuria it occurred in but 5.6 per cent., never alone, and always with serum-albumin; its occurrence was about equally distributed between cases of acute hemorrhagic or parenchymatous nephritis, hematuria, or infection either renal or below the ureters in the bladder or prostate.

Fibrinogen or fibrin occurred in nine specimens from 3 cases, one case of filarial hematuria and two cases of profuse hematuria.

NECESSITY FOR SEPARATING SERUM-ALBUMIN AND NUCLEO-ALBUMIN. The necessity for separating serum-albumin and nucleo-albumin arises when the reaction is faint, since both respond alike to the simpler tests, and serum-albumin has a definite significance, while nucleo-albumin, as far as we know, is of relatively little import, unless possibly indicating the conditions coming under the term "irritation." It is a fact that nucleo-albumin is not commonly present in the urine of chronic nephritis, while it is, as a rule, found in the urine of acute nephritis and subacute nephritis and in inflammatory conditions of the genitourinary tract below the kidney.

In our 3089 urine examinations nucleo-albumin alone was found in 839 (26.5 per cent.) of the specimens. (See Table II.) We have welcomed such positive reaction without serum-albumin in cases of pregnancy and in operative cases in which the kidney to be left behind was thought guilty of a faint albuminuria, particularly, and also in cases of suspected nephritis. With us the commonest occurrence and source of this trace of nucleo-albumin is in the male and from chronic urethral and prostatic conditions. In one case of hydronephrosis with operation its source was undoubtedly renal, and it was the only albumin body present in the fluid from a large non-infected sac, involving a large portion of the renal parenchyma. Whether or not this was a renal nucleo-proteid we were not prepared to prove. In this one case only have we been able to prove absolutely, however, a renal origin for the nucleo-albumin reactions, although it probably not infrequently exists; of the not uncommon prostatic origin we are certain.

The higher percentage of albuminurias in the hospital cases as compared with dispensary cases is striking, and is probably explained by the facts that among the former many were postoperative, and the specimens from nephritic cases were usually examined daily and the non-nephritic weekly.

The discrepancies between the reactions brought out by salting (10, Table II) and between the occurrences of nucleo-albumin (11, Table II) in the hospital and dispensary cases are undoubtedly due

to the relatively frequent occurrence of a normal neutral salt content and of nucleo-albumin in the acute and subacute nephritic conditions with infectious diseases and in acute nephritis (hospital cases), and to the relatively infrequent occurrence of a normal neutral-salt content and of nucleo-albumin in chronic nephritis (dispensary cases).

TABLE II.

	D. Dispens. Mixed specimens.	D. Dispens. Per cent.	H. Hospital. Specimens.	H. Hospital. Per cent.	D.+H. Average per cent.
1. No albuminuria	750	26.5	512	20.5	23.5
2. Total albuminurias	2080	73.5	1988	79.5	76.5
3. Albumin separated	1101	—	1988	—	(3089.)
Albumin, type not noted	979	—	0	—	(979.)
4. Nucleo-albumin alone	269	24.4	570	28.6	26.5
5. Serum-albumin, no nucleo-albumin	344	31.2	176	8.8	20.
6. Serum-albumin + nucleo-albumin	488	44.3	1202	60.4	52.4
7. Albumose (Bence-Jones' albumin)	0	0	0	0	0
8. Serum-albumin + serum-globulin	62	5.6	—	—	
9. Serum-albumin + fibrinogen or fibrin. (3 cases)	9	0.81	0	0	0.81
10. Nucleo-albuminalone or+serum-albumin	757	68.7	1696	85.3	77.
11. Serum-albumin with or without nucleo-albumin	832	75.5	1418	71.3	73.4
12. Reaction after salting only	308	27.9	40	0.21	14.

The necessity for using some such method as salting, heating, and acetic acid (*c*) to bring out or intensify albumin reactions for serum-albumin in urine poor in neutral salts is shown by the fact that 348 specimens (14 per cent.) of the albuminurias reacted distinctly and often markedly after salting only and responded to no other test as well as by the urines from pneumonia cases. Of these specimens many were from 25 nephritic cases, 20 per cent. of the total number of cases of nephritis.

ALBUMINURIA IN CASES WITH CLINICAL DIAGNOSIS OF NEPHRITIS. We do not refer here to those cases of contagious, infectious, metabolic, and toxic conditions which show a disturbance of renal function and probably a transient nephritis, nearly all of which conditions show serum-albuminuria with casts, some of them serum albuminuria without casts when tested with salt solution, heat, and acetic acid, but to cases of well-established Bright's disease in which the first suggestion of the renal condition comes from the symptoms and physical signs.

In proportion to the total number of cases showing albuminuria, 1014, the percentage is small, 12.59 per cent.

As mentioned before, the chronic cases gave no nucleo-albumin-mucin reaction as did the more acute cases. Most important is the fact that many of the chronic interstitial cases, with large amounts of low specific gravity urine, gave no positive tests until the urine had been salted, tested with heat and acetic acid, and allowed to stand for from five to ten minutes.

What we wish to emphasize are the discrepancies between the total cases of serum-albuminuria (1014), the number of cases showing serum-albumin and casts (474), and the number of cases clinically nephritis (125). (See Table III.)

TABLE III.

	Cases.				
	Dispensary.	Per cent.	Hospital.	Per cent.	Per cent.
Albuminuria (=serum-albumin), no casts, clinical diagnosis nephritis	1	0.098	2	0.196	0.20
" " +casts.	104	10.2	21	2.1	12.3
Nephritis=128 cases	105		23		12.59
Albuminuria (=serum-albumin) no casts, clinical diagnosis not nephritis	447	44.	90	8.99	52.9
" " +casts.	174	17.19	175	17.3	34.4
Total cases of albuminuria (=serum-albumin) in 5330 urines	726	71.8	288	28.	100.
Total cases of albuminuria (=serum-albumin), +casts	278	27.4	196	19.3	46.7
No albumin-bodies = clinical diagnosis nephritis	1 exam. 1 visit.		0		0
Nucleo-albumin alone=clinical diagnosis nephritis	0		0		0

Albuminuria does not necessarily, nor does it usually, indicate nephritis, a fact more generally recognized by the genitourinary surgeon than the general practitioner; but it may be indicative of nephritis, and, therefore, cannot be disregarded in diagnosis. From our cases it would seem that albuminuria *with casts* is good evidence of nephritis either temporary, as in the majority of diseases, or permanent in the conditions showing the other evidences (cardiac, circulatory, digestive, cerebral) of Bright's disease.

In no instance has nucleo-albuminuria alone occurred in a case which suggested in any way nephritis.

In only one instance has serum-albumin been absent in a case with the clinical diagnosis of nephritis, in which case but one specimen was examined and the patient was seen but once. In several cases the albuminuria had disappeared entirely after several days or weeks of treatment, during which period the signs and symptoms improved markedly.

Such evidence may suffice for the practitioner, but does not satisfy those of us who look to postmortem evidence as final; for this we refer to the meagre evidence presented by the cases to be published later, which coincide with the clinical evidence.

In only one case and in one specimen was nucleo-albumin found alone with hyaline casts; and in only two cases and two specimens was "no albumin" found with hyaline casts. These observations were made by the same individual. Such occurrences in 5000 specimens of urine do not furnish evidence of value.

We would state, in conclusion, that this material, coming from

variedly mixed services—medical, surgical, gynecological, and numerous dispensary departments—gives a fair idea of the average occurrence of albuminuria in practice. We would emphasize the frequency of non-renal albuminuria and the occurrence of nucleo-albuminuria alone in a large percentage of cases; and would recommend the addition of saturated salt solution with subsequent heating and acidifying with acetic acid as the safest test for serum-albumin. In practice, the separation of the albumin bodies is unnecessary.

We extend our thanks to Dr. Thacher, of the Presbyterian Hospital, for placing at our disposal much of the material studied.

THE PATHOLOGY AND TREATMENT OF NEPHRITIS.

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The kidney stands in very intimate relation to all the other organs of the body and has a twofold function of excretion and secretion. Placed as it is, at the point where the metabolic products of the system may be thrown off or held back according to their nature and their properties of being useful or useless in the further activities of the body, the kidney, with unerring accuracy, quickly excretes those substances which have outlived their usefulness in the economy and holds back those which have further value. In other words, this organ, being the osmo-regulator of the blood and, consequently, the regulator of the composition and concentration of this tissue, shows almost intelligent power of excretion.

It is worth while bearing in mind the fact that an exceedingly close relationship exists between blood supply and functional activity, an instance of which is the numerous capillary tufts shoved into the beginning of the tortuous secreting tubules. An additional point of value, however, is that the afferent artery, which breaks up into the capillary tuft, has a greater caliber than the efferent vein leading from the tuft. It is, therefore, easier for blood to reach the glomerulus than to leave it, inasmuch as the pressure in the capillary tuft is greater than in ordinary capillaries owing to the resistance in the narrow efferent vein and its capillary plexus. This double capillary supply, both on entering and on leaving the glomerulus, seems to suggest the idea that the highly organized part of the renal tubules is protected from excessive blood pressure by the interposition of the glomerulus as a block.

I shall not discuss the facts, pro and con, leading to the assumption of our present theory of renal secretion further than to state that the water, salts, and probably the pathological sugar and albumin

are excreted by the glomerulus, while urea, uric acid, creatinin, with some water and salts, are excreted by the selective activity of the epithelium of the tubules, certain portions of the tubules having different functions in this regard. Naturally, in organic lesions of the kidney disorders of both secreting centres arise, and we have a resulting change in the composition of the secretion. The rate of secretion, necessarily, rises and falls with the blood pressure and also with the velocity of the current passing through the vessels, being influenced, of course, by the activity of the renal epithelium. From the experimental data at hand we must conclude that the process of secretion in the kidney is one of selective activity and not of pure physical filtration.

Modern Conceptions of Nephritis. Normally albumin does not appear in the urine in sufficiently large amounts to respond to our clinical tests. Its presence, clinically, is said to be indicative of a lesion in the glomerular epithelium, as is indicated by the cases of acute interstitial nephritis without albuminuria described by Councilman and others.

It is a very difficult and even impossible task to draw the line between truly physiological or slightly pathological conditions, and those which are clinically characteristic of nephritis. As Stengel says, "The more accurate urinary examinations and the more careful medical diagnoses of recent years have established the fact that it is necessary to distinguish between nephritis in the sense of the pathologist and nephritis or Bright's disease in the clinical sense." The physiological, cyclical, adolescent, orthostatic, and other varieties of albuminuria are rarely, if ever, accompanied by the urinary findings said to be characteristic of nephritis. Febrile albuminuria, on the other hand, is often accompanied, according to von Leyden, von Leube, Senator, and others, by all the elements found in true renal inflammation. We must, therefore, assume that inflammatory lesions in the pathological sense may be present without causing any lasting results, provided these changes have not seriously hampered the functional activity of the kidney. I quote from Stengel: "The presence of slight intertubular exudation of moderate or even extensive, if uncomplicated, degeneration of the epithelium of the tubules, or of slight alterations in the glomeruli, would not justify a positive assertion that the case was one of Bright's disease in the clinical sense. In all of the cases now in mind, albuminuria, the great criterion of nephritis, is likely to be encountered, and yet the pathological conditions are frequently neither serious at the time nor lasting and progressive in character."

The point of all this is, it seems to me, that we must now consider nephritis simply as a renal manifestation of constitutional or metabolic processes. The clinical picture of nephritis may follow these preliminary disorders, depending on the nature of the irritation

of the toxin, the time of its action, and the resistance of the kidney to its action. In other words, nephritis is, in the pathological sense at least, due to a direct irritation of the renal parenchyma by poisons, whether they be exogenous or endogenous in character, which have reached the kidney through the circulation, and which exert their untoward influence on the secreting organ. That direct irritation of the kidneys by bacteria is possible we must grant, although, in this condition, we must assume that the lesions are more focal than when caused by the products of bacterial activity. As Councilman says: "The most easily understood lesions of the kidney are focal in character and due to the presence of bacteria in the tissue. Bacteria often pass through the two capillary systems and lodge in the veins of the pyramids. This is particularly the case in hematogenous infections by Staphylococcus aureus. In this connection comes the question of the passage of bacteria through the intact epithelium. Experimentally this has not been shown to take place. It is true that in certain of the infectious diseases, notably typhoid fever, bacteria are found in the urine, but it has not been shown that the kidneys, in these cases, are intact or that the bacteria come from the kidneys."

In a paper recently read before the Chicago Medical Society, Dr. Brewer, of New York, cited several clinical cases, as well as many original experiments, showing a unilateral multiple abscess formation in the kidney following hematogenous infection by various pathogenic and pyogenic bacteria. Clinically, such cases are manifested by acute gastric symptoms with diffuse abdominal pain, later becoming localized in the flanks, with sudden rise in temperature to 105° F. or more, and accompanied by all of the urinary findings of acute nephritis. Such cases must put us on our guard as to the proper diagnosis of inflammations and infections of the kidneys, inasmuch as the treatment, in the latter cases, seems necessarily surgical. We must remember that not all infectious fevers show nephritis as a common complication, but they may, provided the toxin produced by the metabolic activity of the organism in question, is of sufficient concentration and virulence. Also, in the light of Dr. Brewer's observations, we must consider surgical interference in cases showing the symptom-complex mentioned.

When one considers the etiology of nephritis he finds, in every case, that the causative factor is one which has produced marked metabolic or functional disorders resulting in the production of toxins, irritant poisons, changes in the properties of the blood, and other general pathological alterations, which, in themselves, cause irritative and later inflammatory lesions in the kidneys, resulting in what we call, clinically, nephritis. It must be insisted upon that the nephritis will be of a type distinctly pathological or clinical, depending on factors mentioned above. It may still be nephritis in the pathological sense, without being recognizable clinically.

Owing to this fact, one may not venture a classification of the various types of nephritis without, necessarily, leaning toward the one or the other viewpoint. I shall, therefore, simply treat the subject from the clinical standpoint, leaving out of the consideration the well-established pathological fact that we have types of acute parenchymatous, interstitial, and diffuse nephritis. I fortify my statement that we have the pathological type of acute interstitial nephritis without clinical manifestations, by quoting from Councilman: "The acute interstitial non-suppurative nephritis is found in acute infectious diseases, notably in the acute exanthemata, and consists in the presence in the bloodvessels and interstitial tissue of the kidney of cells belonging to the lymphoid series, which are formed in the bone-marrow, spleen, and lymph nodes, and which are brought to the kidneys by the blood. They accumulate in the renal veins, pass from these into the interstitial tissue, and proliferate actively in both places. Unless the cell accumulation is so great as to interfere with the circulation or nutrition they need not give rise to any interference with function, though usually degenerative changes in the kidney due to the toxins of the disease accompany the interstitial changes. These cells never accumulate in the capillaries of the glomerulus, but are found to a slight extent in the capillaries of the cortex, and chiefly in the veins of the pyramids."

Likewise, in considering the chronic type, care must be taken not to confuse the pathological and the clinical standpoints. The interstitial changes observed in chronic cases are, necessarily, secondary to the parenchymatous if pathology be considered, yet, clinically, we do not find all cases of chronic interstitial nephritis as resultants of the chronic parenchymatous type. We must regard the chronic interstitial type as a phase of a general metabolic disorder manifested through the vascular system.

Influence of Cardiovascular Changes. As is well known, nephritis, depending on its type, may lead to marked changes throughout the cardiovascular system, as well as be the result of such changes. We cannot explain the vascular changes in the same way for the various types. It is self-evident, it seems to me, that the causes leading to a dilatation of the right heart in acute nephritis must be different from those bringing about a hypertrophy of the left heart with secondary dilatation in chronic nephritis.

In the acute forms we must look for our cause in the increased resistance offered through the accumulation of the volume of blood in the vessels. Water, as is well known, is, perhaps, the most difficult substance to excrete in acute nephritis, as evidenced by the marked oliguria or even anuria observed. In consequence of this retention of fluid the right heart must dilate to accommodate the increased amount, and secondarily the left heart hypertrophies in its effort to force the increased load through the system. Depending entirely on how long this increased heart action is kept

up without relief, the result will be sooner or later a breaking down of the compensation and we will then have to deal with a case of heart disease. It is to be said that very rarely does such a sequence present itself in acute nephritis, but it may, as many clinical histories will show. Such clinical pictures are best seen in those acute cases with slight œdema and almost complete anuria. The chronic types are much more often accompanied by this sequence of events.

When we consider the chronic forms of nephritis we see that, although the cause may be different in each type, the result is the same, namely, a marked increase in arterial tension. While in the chronic parenchymatous type the retained metabolic products exert an irritative vasoconstricting effect on the vessels, and at the same time stimulate the heart musculature, the vessels in this type become more permeable and œdema results. Later, the left heart, particularly the ventricle, hypertrophies, owing to the twofold cause of stimulation and increased resistance.

In the primary chronic interstitial nephritis the pressure in the arterial system is high and the contraction of the vessels is great, although the amount of urine is increased. However, the urine in this chronic interstitial form is increased only as regards the water and the easily soluble urinary constituents. In the contracted kidney following arteriosclerosis there is marked interference with the circulation in consequence of loss of tone of the vessels, with resulting increased arterial pressure, and in consequence of the injurious effect of the metabolic products of the blood.

The cardiovascular changes in all forms of nephritis may become so marked that they give rise to the symptoms requiring our greatest efforts, the kidney lesion then becoming of secondary importance from the therapeutic standpoint.

Albuminuria and Cylindruria. As will be granted from what has preceded, albuminuria is a very common finding in conditions which are of general nature and which give rise to nephritis of the pathological rather than of the clinical form. It is an every-day occurrence to find albuminuria accompanying febrile conditions, yet no signs of clinical nephritis appear to settle the diagnosis. It may be stated as a dogma that albuminuria, *per se*, is not necessarily indicative of nephritis in the clinical sense. Yet, judging from our knowledge of pathology, some lesion must be present in the kidney to permit of such a condition. It is quite possible that the so-called alimentary albuminuria is accompanied by some irritative, though slight, lesion in the kidney, resulting in the removal of the albuminous substances from the blood, yet such substances are, to all intents and purposes, foreign to the blood and may simply be excreted as such.

Albumin is usually considered as excreted through the glomeruli, but, in addition, it may pass from the interstitial bloodvessels and lymphvessels into the urinary tubules, so that, primarily, we may

conceive of a glomerulitis whenever albuminuria exists. Either disturbances of circulation, irritation of the parenchyma of the kidney, or changes in the blood may be held responsible for the pathological albuminuria. Space will not permit of a discussion of the theories of Semmola, Lepine, and Rosenbach. It seems to me that it is not improbable that we may, by diligent research, show that differences exist in the albuminuria from various causes. I mean by this that we may find, and certain evidence from experimental work seems to strengthen the assumption, that the albumin excreted in pneumonia, for instance, is different chemically from that observed in nephritis following exposure or excesses. Whether this is or is not the case will be shown, I believe, by the application of the principles so well worked out by Emil Fischer. It is not inconceivable that the various etiological factors of nephritis, particularly the toxic products of bacterial growth, may, in their formation, cause the disintegration and resynthesis of the serum albumin into proteid bodies with different arrangement and different concentration of the various amino-acids, of which they so largely consist. Such bodies would give our clinical tests for albumin and would not be distinguishable from serum-albumin from the clinical point of view.

Regarding cylindruria, it is to be said that here, also, we must be on our guard lest we err in our diagnosis of nephritis. Casts of all kinds appear in the urine in cases showing no clinical manifestations of nephritis, yet we must assume, if our ideas of the origin of casts are correct, that a lesion of the kidney exists. As Emerson says, "Casts alone are no index of the anatomical renal condition. Their most brilliant display is in non-nephritic conditions; the most serious conditions in nephritis may be accompanied by few or none. The more normal the cells the better do they seem to form casts when disturbed: in chronic conditions the cells seem to become accustomed to their condition and to form few casts or none."

Chloride Retention. Since the publication of Widal and Javal in 1903 a large number of French and a few German workers have busied themselves with showing that sodium chloride is, contrary to our well-established ideas, a decidedly harmful substance in cases of nephritis. Although Widal and Javal, Achard, Loeper, Claude, Bohne, Castaigne, and others did not originally apply their idea to any but the parenchymatous variety of nephritis, later workers, such as Achard and Paisseau, Brandenstein, Calabrese, Chauffard, Olmer and Audibert, Merklen, Lesne, Vaquez and Laubry, Strauss, and others have extended this original idea to interstitial nephritis, cardiac and hepatic dropsy, epilepsy, etc. These workers have found that the chloride is retained in the system, that concurrently the œdema is increased, and a greater albuminuria is noted. Some recent work of Miller has shown that there is quite as much retention in normal individuals as in nephritics. That œdema is not observed

in the normal goes without saying. Ferrannini has shown that although chlorides are retained in nephritis and albuminuria is increased, the general betterment of the condition warrants the use of this substance as a subcutaneous injection. Rumpf, in a recent article, shows that the idea of retention of sodium chloride as an etiological factor in the causation of the œdema of nephritis, is not well grounded. Richter confirms this and argues that sodium chloride is no more responsible for the œdema than are many other factors, especially the amount of water intake. Marischler shows that the kidney of parenchymatous nephritis is permeable for sodium chloride and that the retention is explained by the primary retention of water. Kövesi and Roth-Schulz confirm this idea, and go farther into the physical explanation of the œdema. We observe, therefore, that this assumption of the causal relation of retention of chlorides to the œdema is debatable.

It may be well to ask, How does sodium chloride act in the normal and how in the nephritic metabolism? When NaCl is administered by the mouth it, of course, is absorbed from the stomach and bowel. The blood becomes more concentrated; hence, water passes from the tissues into the blood making this hydremic. The excess of water and of salt is normally excreted by the kidney, since this organ is the osmo-regulator of the blood. NaCl acts, therefore, just as any other salt, such as the citrate or acetate would act, as a diuretic, owing simply to its "salt action." The question might be asked in this connection, Why normal individuals show a retention of chloride? The answer must be rather vague in the present state of our knowledge. The amount of NaCl in the blood, according to Hammarsten, is 6 per 1000, and this amount remains almost constant. With food containing an excess of NaCl, this excess is quickly eliminated, and with food poor in chlorides the amount in the blood first decreases but later increases, after taking chlorides from the tissues. The secretion by the urine is thereby diminished and apparent retention occurs. This retention, it must be insisted on, is only apparent and vanishes as soon as the proper osmotic equilibrium has been established between tissues and blood. According to Marie there are two stages in the retention of chlorides, and these stages depend, of course, on the laws of osmotic pressure and of chemical equilibrium. The first stage of retention, as Marie puts it, is that of fixed chloride (tissue), namely, the combination of the NaCl with the proteids of tissues, which assumption has been experimentally shown to be possible by van Bemmelen, but is doubted by Bugarsky and Liebermann. The second stage is that of circulating (interstitial) chloride. This added point shows us how in the first stage we get a retention, if the NaCl of the blood is insufficient, owing to a poor intake, and is then increased by food rich in NaCl.

If now the kidney is "insufficient," or, in other words, is unable,

owing to the inflammatory processes affecting its excretory activity, to excrete the excess fluid and its constituents, there occurs a retention of salt in the circulatory system, a hydremia, and at the same time a plethora, vascular pressure is increased, transudation through the capillaries follows, an attempt is made to adjust the osmotic pressure of the blood and the tissue fluids, salts pass into the tissues, which, in time, become hypertonic, and, in consequence, water follows the salts into the tissues, and œdema occurs as a combined result of increased vascular pressure with transudation and the retention of salts in the tissues. This theory of œdema as a result of osmotic exchange between the blood and tissues was advanced by Loeb in 1898, and has been reached by the French school, especially by Widal and Javal, working from different standpoints.

It is difficult to say just why nephritics show increased albuminuria after increased intake of NaCl, yet one may call to mind the results of Hoppe-Seyler, von Wittich, and Nasse, showing that an albuminous solution filters stronger the greater its content of salt. This purely chemical fact may also be applicable, as far as the purely physical theory of filtration through the kidney is concerned. On the other hand, one may assume that the kidney has become more permeable for albumin, or that the albumin itself has become more diffusible, inasmuch as various workers have shown that normal individuals, in time, show an albuminuria under the influence of increased intake of NaCl. There are difficulties in the way of both explanations. In the first place, if the kidney has become permeable for albumin, then would it not be permeable, at the same time, for the increased chlorides? If the albumin is more diffusible, it is not as diffusible as the NaCl, and yet the latter remains and the former passes out. We must again revert to the osmotic theory for our explanation. Proteids possess only a slight osmotic value, while the salts have very large equivalents. The osmotic and the diffusion currents extract the fluid and the salts first from the tissues and then later from the blood back into the tissues. The proteids are not affected by this interchange, unless we may assume, with Semmola, that some change in the constitution of the proteids, by which they become more diffusible, is brought about in nephritis.

In this connection, I wish to mention some experiments which I began under Senator and have continued at the Cook County Hospital in Chicago. It was found that the urine of nephritics showed the separation of a coagulatory inhibitory substance and at the same time of a distinct ferment with marked peptic characteristics. This latter was in all probability simply an increased amount of the normal peptic ferment found in the urine by Grober, Gehrig, Grützner, Mathes, Rosenberg, Stadelmann, and others. This separation of a substance in the urine which favored or inhibited coagulation of proteid in pneumonia has been previously worked out by Lenobel, Kun, and Lochbihler. It is possible that

the albumin becomes more diffusible solely through the presence of these two substances whose identity I am at present unable to disclose. It is, however, a very strange fact that NaCl will increase or cause an albuminuria. The explanation best suited, it seems to me, is that we have a pure toxic albuminuria. This toxic action of NaCl is well known physiologically from the work of Loeb, Moore, Neilson, and others.

ŒDEMA. I shall refer in this connection only to the œdema caused by the lesions of the kidney resulting in certain pathological changes of the metabolism of the fluids and solids of the blood and tissues. I exclude a discussion of cardiac and hepatic œdema as well as of "hydrops cachecticus," which have no direct place here, although I am convinced of the correctness of the reasoning of Kövesi and Roth-Schulz that the cause of cardiac and renal œdema is a common one.

We must abandon the old conception of Bright's that œdema is caused by hydremia of the blood resulting from the loss of albumin, in consequence of which the watery constituents more easily passed out of the vessels, just as we must give up Bartels' and Stewart's ideas of a hydremic plethora, because we can show that retention of urine, *per se*, will not bring about an œdema. Cohnheim assumes an inflammatory change in the vessels by which they become abnormally permeable. Senator remarks: "Under the influence of certain injurious properties of the poison circulating in the blood, the capillaries of the glomerulus suffer first and then, if the injurious action be strong enough and long enough continued, the interstitial and other vascular areas outside of the kidney, such as those of the skin and serous cavities, become affected. A glomerular affection is always to be looked for when œdema is present, but not vice versa."

Kövesi and Roth-Schulz would make the insufficiency of the kidney in itself responsible for the changes resulting in œdema. The changes in the kidney excite abnormal metabolic processes by increasing the watery and solid constituents of the blood and preventing the elimination of the poisonous toxic and autolytic products. As a result of increased vascular pressure combined with abnormal permeability of the capillary walls and increased osmotic change œdema follows. It is well to remember in this connection the role played by the perspiration, both sensible and insensible. As Bidder and Schmidt, Seegen, and others have shown, the amount of perspiration depends on the temperature and the degree of saturation of the surrounding air. However, it is a well-known fact that nephritics perspire very slightly. von Koryani comes forward with an explanation of increased osmotic pressure of the blood, raising the point of evaporation of fluid, and, hence, decreasing the perspiration. It is possible thus to explain a part of the effect of NaCl in increasing the œdema by lessening the loss

of water by the skin and lungs. The amount of fluid taken in is also a large factor in the causation of the œdema. As the fluid is absorbed just as it is normally, the hydremic condition is increased, and with the resulting insufficiency of the kidney, water elimination being the first abnormal phase noticed when the kidney becomes affected, aggravation of an œdematous condition follows. There is thus a distinct reason for limiting the intake rather than increasing it, as we cannot flush the kidney in this way owing to its lessened excretory activity. The result is an overburdening of an already highly taxed heart and an increase of the œdema.

Uremia. In this discussion, up to this point, I have not attempted to take up the effects of nephritis on the system in general. Under the head of uremia one must bring in certain points of general pathology and pathological chemistry in an attempt to show that this condition is a result of purely metabolic processes. As œdema is a combined result of renal and vascular causes on the metabolism, so is uremia the result of changes on the cerebral centres and on the digestive system, due to disturbances in general metabolism, together with insufficient kidneys. The subject of autointoxication is one of general interest whether it be enteric, hepatic, or renal.

The theories advanced as to the causation of uremia have for the most part as a basis the idea of overloading of the blood with urinary constituents as a result of insufficient kidneys. Opposed to these theories are those that hold that hydremia with resulting œdema of the brain is at the bottom of the symptomatology. These latter ideas are especially advocated by Rees and Traube, but do not seem to be convincing, inasmuch as certain factors assumed by the advocates are at times missing and hence cannot be regarded as causative of all cases. I refer here, of course, to the hypertrophy of the heart and to the brain œdema. We must, however, grant that the œdema, when present, may be responsible for certain nuclear symptoms observed in uremic attacks.

Space will not permit an enumeration of all the factors advanced in support of the chemical theory as opposed to the physical. We all know that the retention of almost every constituent of the urine has, at one time or another, been held to be as the causative factor in uremia. One by one these substances have been abandoned until now we cannot grant that any one substance is specific in the causation of this group of symptoms. From the time that retention of urea as an etiological unit was advanced by Wilson until the list had been exhausted by Bouchard in his assumption of organic urotoxins, we have been obliged to change our ideas of the factors responsible for the trouble under discussion. Opposed to these views are those of Frerichs, Demjankow, and the closely related one of Treitz, which assume an ammoniemia as the causative agent.

Strauss found that ammonia was increased in the blood, but at the same time other nitrogenous bodies (neither albumin nor urea)

are present, which must play a role in the etiology of uremia. He shows that while the salt content of the serum in uremia does not change, the amount of the nitrogenous constituents contained in the hydremic serum, that is, the retention nitrogen, is, as a rule, increased to a great extent. In connection with this work of Strauss one must mention the findings of Gumlich and Richter that ammonia, alloxur bodies, and extractives are markedly increased in the urine of uremics. It is unnecessary for me to discuss the relation of an increased ammonia excretion to an increased acid formation in the tissues. This regulation of the metabolism is a well-established fact. This taken with the idea of Strauss gives us a very rational basis for the etiology of uremia. Recently, Croftan, reviewing the facts given above, as well as certain points brought out in his own experience, advances the theory that uremia is primarily dependent on insufficiency of the liver, following a general metabolic disorder, and that the kidney is only secondarily important in the causation. This theory has a certain element of plausibility, owing to the fact that, in just such cases of insufficient liver, disturbances of the urea formation, ammoniemia, and irregular autolysis occur and lead to increased acid formation either of the amino or oxy series. However, were it not for the disturbance of the excretion by the kidney, uremia would not occur. The general metabolism of the proteids is at fault in the theories advocated by Senator and by Croftan. As Croftan says, "The liver is not the only organ affected, and uremia interpreted as above is not so much the result of hepatic derangement as of a general metabolic disturbance."

This view of the terminal syndrome of some forms of nephritis is quite in harmony with our idea of nephritis as primarily a constitutional disorder with secondary involvement of the kidneys.

TREATMENT. In a discussion of the treatment of the various forms of nephritis emphasis must be laid, at the beginning, on the individual factor in the handling of our patients. It is very irrational to order, for instance, an exclusive diet of milk in all cases, just as it is unsound treatment to deprive all of the nephritics of dark meats. Each case is a law unto itself, and, in consequence, I cannot attempt to do more than lay down general principles which may be varied to suit the particular case in hand.

Dietetics. No factor in our handling of a nephritic patient plays a greater role than the dietetic treatment. A rational basis for such treatment has at last been worked out, thanks to von Noorden and others, so that we are today working with surer principles than before.

As a general rule, it may be said that, in the beginning and during the height of an acute nephritis, starvation for four or five days is the best treatment. Of course, this starvation diet need not be absolute in all cases, as for instance in the lighter types which we observe in most fevers; but in the forms following scarlatina, for

instance, starvation more or less absolute depending on the intensity of the process, as shown by oliguria and marked œdema, must be practised. It may be stated here that we should not, for reasons previously mentioned, judge too severely from the amount of albumin or the number of casts; but we should rather watch the clinical symptoms closely for signs of general disorder. It is much better practice to follow the œdema and the heart symptoms rather than the urinary in drawing conclusions as to the severity of a special case. As we know, recovery usually follows in cases of acute nephritis if a certain period of danger can be passed through. It is our duty to avert this danger, if possible, and, therefore, starvation is to be forced in cases of greatest severity, limiting the intake of fluid as far as possible, and giving ice to quench thirst.

It is a matter of common knowledge that in acute nephritis water is the substance most difficult to get rid of through the kidneys. How irrational then is the idea of ordering a rigid milk diet and forcing water. The main effect of such treatment will be the overloading of the blood with material that cannot be excreted, and thus increasing an already existing œdema, and, at the same time, causing the heart to work harder to force the increased volume of blood and, in consequence, increasing the danger of hypertrophy and later dilatation of this organ.

In cases which are less severe and are not accompanied by a high degree of oliguria and œdema, milk to which has been added a little calcium carbonate to form the insoluble calcium phosphate may be given in quantities not to exceed, on the average, three pints, and the remaining caloric value necessary to maintain the standards of the system may be made up of fat in the form of cream and cereals. It must be remembered that, in our efforts to protect the kidney from overwork, we must not go so far as to injure other organs and, at the same time, the whole organism. The principle of "Schonungstherapie" has certain natural boundaries and these must not be overstepped. Our idea must be to preserve the general nutrition at as high a standard as is compatible with the best working powers of the kidney. We therefore gauge our diet largely by the degree of oliguria and œdema, decreasing the former as the latter increases, and vice versa. Meat broths should be interdicted to the last, inasmuch as these contain, practically, nothing but uric acid, purin bases, and creatinin, and, in consequence, can have very little nutritive value and may irritate the kidney attempting to excrete them.

In the later stages of acute nephritis the food may be gradually increased as desired, care being taken to avoid a large excess of proteid. As is often the case, three or four quarts of milk are given daily in the convalescent stage. Such treatment is bad because the fluid, finding its way into the circulation, may overburden a weakened heart; furthermore, the amount of proteid thus introduced

is unnecessarily high. It may be said that it is unnecessary to limit the patient to white meats by depriving him of the red meats. No difference is found between them as to their influence on the general metabolism and on the regenerative processes in the kidney.

Exactly the same procedure as outlined above should be followed in cases showing acute exacerbations of the chronic form.

When we consider the chronic types of nephritis we have a different viewpoint to study. These types are essentially chronic, that is, they continue for long periods of time. As curing such a case is, at present, out of the question we should direct our efforts to maintaining the general body activity at as high a plane as is consistent with the condition of the kidney. Sooner or later the chronic forms, particularly the interstitial type, become practically heart cases and should be treated as such. We are, therefore, justified in allowing the patient more or less latitude in the choice of his diet, remembering certain precautions. The intake of fluid should be limited to some extent. The idea of forcing a milk diet with plenty of water is harmful not only to the kidney, but, what is more important, to the heart. A liberal proteid diet is permissible and no difference need be made as to white or red meats. Condiments are to be avoided as far as possible. Fresh fruits and vegetables may be ordered as desired, recalling the fact that von Noorden advises against the use of radishes and celery, but permits asparagus. Coffee, tea, alcohol, and tobacco should be used with great moderation.

In regard to dechloruration, it is to be said that the limitation of salt in the diet is unnecessary, since it seems to me that the theory upon which its deprivation is based is not tenable. Experiments are still necessary to prove that the œdema is dependent on the retention of salt and also to prove that the salt is actually instead of apparently retained. It is true, however, that some cases are benefited by dechloruration, but it seems to me doubtful that such results are due entirely to the withdrawal of salt.

It must be recalled that each person needs a certain definite amount of energy to maintain himself in healthy equilibrium. With a nephritic, the same thing is true within certain limits. As the energy comes from the food it is rational to construct the diet with definite caloric values in view, remembering that it is advisable to restrict the fluids to some extent and to confine the proteid intake within 100 grams (on a basis of 70 kilograms of body weight). If the reasoning of Chittenden and Folin is correct we must reconstruct our ideas of the proteid need of the system to a basis far below that of the old-established formula of Voit (118 grams of proteid on a basis of 70 kilograms of weight). An excess of proteid is the dangerous thing in the dietary of a chronic nephritic.

We must not forget in our dietetic treatment of nephritis that the digestive powers of the patient should be carefully watched. The

digestive tract is a prolific source of toxemia and should, therefore, be carefully regulated. Likewise, the functional power of the liver should be maintained at a high standard to protect the system against accumulation of abnormal products of a deranged hepatic metabolism.

Hygienic and Physical Therapy. Almost as much importance attaches to these phases of the treatment of nephritis as to the dietetic. It is naturally in the chronic types that we have to do with such measures to the greatest extent. Of course, in the acute forms we resort to sweating and purging processes with the idea of relieving the kidney of unnecessary work and at the same time of controlling the œdema. As these sweating processes are, in some cases, very weakening, it is good practice to stop them at the first sign of weakness of the heart, provided no uremic symptoms are present; if these develop, we must, of course, use all our efforts to control this condition. It is irrational to allow the free use of fluids and then force the sweating process, since both treatments are followed by weakness of the heart.

In chronic types, hydrotherapy plays a helpful role in aiding the elimination of water and salts, but it in no way aids the excretion of the harmful nitrogenous products. Proper clothing, preferably woollen, and bathing are to be ordered, and the patient should be directed to spend as much time as possible in the open air. The drier the air the better, as this aids the evaporation from the skin. Exercise is a very important element in the proper handling of these patients, but should never be indulged in to excess. Exercise tends to strengthen a weakened heart, but if excessive will lead to serious complications, as the heart is necessarily under great strain in all cases of chronic nephritis. Moderation in all things is the key-note of the hygienic and physical treatment of these cases.

Symptomatic Treatment. There are several indications for the treatment of nephritis which may fall under this heading: (1) Maintenance of cardiovascular equilibrium; (2) regulation of the œdema; and (3) regulation of the bowels and of the liver. The first two of these are more or less closely related, inasmuch as the œdema is partially a result of disturbed cardiovascular equilibrium.

The maintenance of the cardiovascular equilibrium is, in most cases, of the greatest importance. As the essential feature of the circulatory change is a high arterial tension with or without œdema, it is readily seen why we should be on our guard in following such cases. The œdema may come from the kidney lesion direct or later from the breaking down of a compensated heart. It is usually only a matter of time until this latter factor enters into the case. It is important to recognize which of these two factors is predominant in the causation of the œdema, as the treatment is somewhat different in each case. In those cases in which the heart is fully compensated, our indication is to regulate the blood pressure within safe bounds,

a certain degree of increased pressure being necessary. These cases should always be followed with some instrument to indicate the pressure, as a routine. As stated above, a careful dietetic and hygienic regulation, together with free action of the skin and bowels, is usually adequate in controlling the arterial tension and œdema. If these measures do not prove effective, we must use some vasodilator drug or a combination of such drugs in our efforts to maintain a proper equilibrium. The nitrites of sodium or potassium are often found beneficial. Erythrol tetranitrate or nitroglycerin is often given with this object in view. As a general rule, we should resort to vasodilatation whenever the pressure in the adult male reaches 150 mm. of mercury, and at even lower pressures in the female. Diuretics are unnecessary and do no good in purely renal œdema. We may resort to colonic irrigation, which may prove useful in reducing the arterial tension and œdema.

There is no indication for digitalis in the treatment of nephritis as long as the heart is compensated. However, when signs of failing compensation appear and the œdema becomes one of the cardiorenal type, digitalis is the drug to use. As long as the preparation is trustworthy any form of this drug may be used, although we are taught that the infusion has special merit in such cases. Care should be taken to watch the action of the drug lest its action becomes cumulative and the second and third stages of its action become manifest.

I have spoken already concerning the proper regulation of the bowel and the liver. I need only say here that this indication is very important, since we have in the digestive tract, as well as in the liver, a source of constant danger. Enteric and hepatic toxemias are too common to need discussion.

Tension of the skin from the œdema is to be relieved by puncture under aseptic precautions. Effusions into the various serous cavities are to be handled by puncture or paracentesis, depending on the location.

As the heart becomes more and more weakened, we find that the patient complains of dyspnœa, dizziness, etc., in the reclining posture. In such cases the upright position is best suited to ease these symptoms.

Care should be taken to watch for symptoms of uremia and to give brisk purgatives and diaphoretics as soon as precursors, such as stubborn headache, dizziness, nausea, vomiting, etc., are noted. In view of recent advances it might be advisable to force an alkaline treatment with the view of neutralizing the excessive acids produced. Venesection may be resorted to if the blood pressure gets too high. Subcutaneous and even intravenous saline injections will often aid the system in throwing off the substances which are at the bottom of the trouble

Surgical Treatment. In recent years surgical treatment has been advocated, especially by Edebohls and Ferguson, in the chronic types of nephritis. Briefly stated, the surgical intervention consists in nephrotomy or decapsulation. This procedure leads to an increased elimination by drainage of the accumulated products. As the operation is done in the primary stage of anesthesia, the untoward effect of the anesthetic is very much lessened. The whole operation consumes only three to four minutes, and, judging from case reports, is often very beneficial. Much may be expected of this form of treatment, as it is surely rational in some cases and is successful in many.

In cases such as those described by Brewer, nephrectomy seems to have yielded cures. It may be that, in these forms also, decapsulation with drainage will be useful; it will lessen the danger of operative procedure.

THE USE OF THE X-RAYS IN UNRESOLVED PNEUMONIA.

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That exposure to the *x*-rays might be useful in the treatment of unresolved pneumonia was suggested by one of us[1] in discussing the effects of the *x*-rays on metabolism in leukemia. It was then stated that the remarkable effect that this agent usually exerts upon metabolism is most readily and most satisfactorily explained by considering it to be due to action upon ferment processes normally resident in the tissues; the action in this instance apparently being to accelerate autolytic processes inherent in the tissues. The reasons then evident for adhering to this view were given at that time, and continued studies of the effect of *x*-rays upon metabolism in various diseases—studies now amounting to twelve—have emphasized our opinion that this is the most satisfactory conclusion to be reached. Further consideration will be given this point in a more extended discussion of the accumulated results in the various conditions studied, and it is, therefore, unnecessary to burden the present communication with it.

Granting the correctness of the view mentioned concerning the

[1] Musser and Edsall. Trans. Assoc. Amer. Phys., 1905; Univ. Penn. Bull., September, 1905.

action of the *x*-rays, the idea at once presents itself that treatment with this agent may be beneficial in many conditions in which metabolism is not sufficiently active; but there is great difficulty in determining this point, on account of our very limited knowledge of most conditions in which such metabolic inactivity is suspected of being present. As was said, however, in the paper first referred to, our present knowledge of the process of resolution of a pneumonic exudate indicates that unresolved pneumonia is the most evidently suitable condition in which to try the effect of the *x*-rays from this point of view. We know that ferment processes cause the digestion and resolution of the exudate in the ordinary pneumonias that pursue a satisfactory course; and lack of resolution, while sometimes really a continued inflammation, appears from Flexner's observations to be often due to insufficiency or absence of digestion of the exudate. In the latter case evidently the rational therapy is, if possible, to excite or accelerate the action of the ferments that should digest the exudate.

The possible suitability of the *x*-rays as a therapeutic measure in this condition led to its being used, in April, 1905, in a case that has already been mentioned.[2] Since that time we have kept under careful observation the cases of delayed resolution of pneumonic exudate that have come to our notice, with a view to choosing from them, for this treatment and for a study of metabolism while under treatment, those cases that seemed fairly certain not to undergo resolution under ordinary treatment, or to resolve so slowly and imperfectly as to lead to permanent crippling of the lung. We limited our choice also to cases in which noteworthy fever and all other evident signs of continued active pneumonitis were absent.

Of the five such cases that became available—all fever and evidences of distinct toxemia having disappeared, and the signs of solidification having been stationary for at least ten days or a fortnight—three patients grew weary of the waiting that we had imposed upon them and insisted upon leaving the hospitals in which they had been kept under observation, so that our further studies of this question have been confined to two cases. The conditions of metabolism observed in these cases while under treatment with *x*-rays were, however, so striking and the clinical effects in them and in the case previously mentioned appeared so uniformly good, that it seems proper to describe the results in them, in order to encourage a more extensive test of the treatment. In such tests, however, a few considerations need to be kept in mind, in order that the conclusions may be just.

In the first place no results can be expected unless the duration of the condition has been reasonably short—a few weeks at most—

[2] Musser and Edsall, loc. cit.

for, if organization of the exudate has occurred, a satisfactory result of treatment is almost inconceivable.

Secondly, the condition should be chiefly a real lack of resolution and not a continued inflammation of the lung. We are unable to state what effect the *x*-rays may have upon chronic pneumonia, but we are not dealing with this point; and in testing the effect upon delayed resolution as such, active continued inflammation should be excluded as far as possible. To exclude even slight grades of chronic inflammation would be exceedingly difficult, for such slight grades produce no symptoms that are distinguishable from those due to the exudate itself; and, indeed, a low-grade inflammation is probably always present, even comparatively early, and certainly when organization begins. Such a condition we could not reasonably desire to exclude, but we should exclude those cases in which decided fever and other evident symptoms of persistent active inflammation and toxemia exist; for, when these are the chief abnormalities present, resolution of the exudate may be impossible, and may also be of little or no value for the time being. In the low-grade inflammation, however, that appears to be due largely, and perhaps entirely, to the persistence of the exudate, resolution of the latter would probably be accompanied by cessation of the inflammation.

Thirdly, it is excedingly important to determine, as far as possible, that one is actually dealing with unresolved pneumonia and not with tuberculosis. Many cases that are hastily thought to be unresolved pneumonia are, of course, unquestionably tuberculous; and judgment as to the value of a treatment of unresolved pneumonia cannot be based upon them. If cases fail to resolve under the influence of the *x*-rays, it should be determined before using them, in reaching a decision, whether they are or are not instances of tuberculosis.

Finally, we would earnestly recommend that the use of the *x*-rays in the treatment of cases of this or any other kind be undertaken with a proper realization of the fact that there are dangers associated with it; and the treatment should, therefore, be begun tentatively, and with brief exposures and small doses, until it is determined in the individual case that serious results are not likely to ensue. This is an additional reason for excluding those cases in which there is marked fever and in which other evidences of toxemia are present. For reasons that we shall point out in another paper, we are convinced that persons that are already the subjects of a noteworthy degree of toxemia are more likely than others to be dangerously affected by exposures to the *x*-rays; and until our knowledge of the contraindications to the use of the *x*-rays becomes better defined, we believe that with all such persons the use of this agent should be withheld unless there are urgent reasons for administering it.

We would also at this point, and for the reason just given

advise that the *x*-rays be not tried, at least until their effects are better understood, in the treatment of pneumonia during the course of this disease. Such treatment has already been used purely empirically, and if we are correct in thinking that resolution may be hastened in unresolved pneumonia by the use of the *x*-rays, a very natural corollary of this idea would be the thought that exposures to the *x*-rays during the course of pneumonia might hasten resolution and shorten or favorably modify the course of the disease. We do not, however, subscribe freely to such a notion, the chief objection to it being that the most important factor in the course of most pneumonias is not the presence of a mass of exudate in the lung, but the presence of a dangerous toxemia. Resolution of the exudate might, if it could be accomplished, be associated with control and reduction of the toxemia, but it is equally possible that it might not influence the toxemia to an important degree; and the point we would make at present is that whatever might be the result upon the local mass, there is actually serious danger that, if resolution could be accomplished, the sudden digestion of the exudate and absorption of its products might, if occurring during the course of a severe toxemia, be productive of much more harm than good.

The main clinical features of our cases will first be given, including the case that has already been briefly reported in the paper referred to.

Case I.—A man, aged fifty-six years, was admitted to the Episcopal Hospital in the service of Dr. A. A. Stevens, on March 13, 1905. He had been taken acutely and severely ill three days before with high fever, dyspnea, and pain in the right side; and presented the usual signs of a pneumonia involving the whole right upper lobe. His disease ran a moderately severe course, and crisis occurred on March 20. The fever and the signs of toxemia disappeared at this time, but the consolidation persisted, and was still present and but little changed when seen by Dr. Edsall on April 1. There was no noteworthy change, except a very moderate degree of lessening in the intensity of the signs, up to April 21, on which date it was ordered that he be given over the affected area five-minute exposures to the *x*-rays. These were continued for four days.

During Dr. Edsall's temporary absence from town, Dr. George W. Norris kindly watched the course of the case during the next week. There was no special change in the man's general condition, which was already satisfactory, but on April 23 it was noted that there were many rales in the affected area of the lung and that the breathing was somewhat cavernous in type in the upper portion of the lobe, below this bronchovesicular. Three days later he was noted still to have a moderate number of rales in this lobe, while the breathing had become bronchovesicular everywhere. The dulness had greatly decreased. When seen by Dr. Edsall on April

27 the rales had disappeared; there was very slight dulness over the upper half of the lobe, with no dulness elsewhere; the breathing was a little weak over the whole lobe, expiration being slightly prolonged. A week later, when discharged, there was, except for slight weakness of the breath sounds over this lobe, practically no abnormality left. The man's general condition was entirely satisfactory.

CASE II.—A Norwegian sailor, aged twenty-eight years, was admitted as a British Consul case to the University Hospital under the care of Dr. Hollingsworth Siter, who kindly gave us the opportunity to study the patient. It was difficult to secure a detailed history from him; but it appeared that while at sea he had been taken acutely ill with fever, dyspnœa, and pain in the left side. He had been ill for eight days, when he had had an apparent crisis; and the day following, when he arrived in port, he had been sent at once to the University Hospital. When admitted his temperature and pulse were normal and his general condition was entirely good, but he still had the signs of marked solidification in the left lower lobe, involving the whole of the upper part of the lobe and reaching down to the level of the ninth rib.

For three days there was no change in these signs; but throughout the next five days there appeared to be a slight improvement, the dulness becoming less intense and the breath sounds less harshly bronchial. From this time on, however, for two weeks the signs remained stationary; and when he was first exposed to the *x*-rays he had, over the whole upper part of the left lobe down to the level of the ninth rib, a moderate degree of dulness, with moderate bronchial breathing and increased fremitus. Rales were absent. An *x*-ray picture was taken at the first exposure, and this showed a moderately intense shadow in the area corresponding to the signs described.

He was exposed daily for seven days. Two days after the first exposure there was no striking change, although it was noted that the dulness was perhaps less marked and that there were a few fine rales in the affected area. Two days after this it was noticed that the dulness had receded upward for about an inch and a half and that even above this point the dulness was less marked; the breathing was much less harsh, and was bronchovesicular; it could not be determined that the fremitus was increased, and there were many fine rales over the upper part of the lobe. Three days later, at the end of the experiment, no abnormalities could be discovered, except slightly weak breathing over the diseased lobe and a small area of dulness, about an inch in diameter, at the upper extremity of the lobe. An *x*-ray picture taken at this time showed nothing abnormal except a small, indistinct shadow at the area in which a trace of dulness was still found. The man appeared to be entirely well in other ways.

CASE III.—A Cuban, aged thirty-four years, was admitted to the Pennsylvania Hospital, in the service of Dr. Arthur V. Meigs, who kindly gave us the opportunity to study him. Dr. Longcope also made frequent notes of his case, of which we shall give an abstract, and was likewise kind enough to watch carefully over the details of the weighing of his food in the metabolism experiment, the securing of the twenty-four hours' urine, etc.

The patient was admitted on the fourth day of an illness that had come on with the usual symptoms of an acute pneumonia of the right side. Examination of the right lung showed dulness over the whole lower lobe, with bronchial breathing and increased fremitus and vocal resonance, and with fine crepitant rales over this area. The upper portion of this lung was negative, as was the left lung. The examination, otherwise, is of no consequence. On the 5th, his condition was worse, the pneumonia having extended throughout the lung. The signs over the lower lobe, however, had decreased somewhat in intensity. On the 8th, he had the usual signs of crisis, but the lung remained solidified. Three days later the lower lobe appeared to be slowly clearing up, but the uppper lobe remained solidified. On the 21st, thirteen days after the crisis, the lower lobe had cleared up with practical completeness, but the upper lobe remained unchanged and was entirely solidified. Tubercle bacilli were absent from the sputum.

On this date the first *x*-ray exposure was given him, a picture being then taken which showed a shadow corresponding with the signs of solidification in the upper lobe. Two days later it was noted that the breathing was less harsh and the dulness less marked, but the signs were not strikingly changed. On the 26th the signs were decidedly less marked, dulness and bronchial breathing being much less pronounced. On the 28th there was still some dulness, but it was decreased. The breathing was blowing, but not distinctly bronchial. On March 1 the dulness reached only to the third rib, and was slight, the breathing still being somewhat blowing. On the 3d the signs were about as last noted. On the 6th there was still slight dulness to the third rib anteriorly. Posteriorly, the resonance above the spine of the scapula was skodaic. The breath sounds were somewhat harsh over the dull area, but not tubular. Rales were absent. The patient was discharged two days later, at his own request, in apparently normal condition, except for the signs mentioned. The *x*-ray exposures subsequent to the 21st occurred on the 24th, 26th, 27th, and 28th of February; and the 1st, 3d, 4th, 5th, 6th, and 7th of March.

Metabolism experiments were carried out in the two cases last described. As previous studies had shown no noteworthy influence of the *x*-ray exposures upon absorption from the alimentary tract the feces were not studied. The patients were given a diet composed of milk, bread, butter, eggs, rice, potatoes, and sugar. The food was from

the same source each day and was accurately weighed or measured. The amount of nitrogenous intake was calculated from the weight records of the food, using figures that we had previously obtained from numerous determinations of the same food. The salt also was kept at the same amount each day, in order that variations should not influence the chloride determinations; and it should be noted that the diet was purin-free and hence that variations in the uric acid were due solely to changes in metabolism, and not to changes in the food. Before studies of metabolism were begun, the patients were put for three days on the diet described. For several days control studies were then made, and after this the *x*-ray exposures were commenced. Each "x" in the second column indicates an exposure; it is to be noted that the effect is shown in the figures of the following day.

TABLE I. CASE II.—URINE.

Date.	*x*-ray exposures.	Nitrogen ingested Grams.	Nitrogen.	Chlorides.	Uric acid.	Phosphates.
Jan. 12	...	6.54	8.971	12.600	0.2295	1.900
" 13	...	6.54	5.262	8.262	0.1944	1.296
" 14	...	13.08	14.840	11.125	0.3022	2.710
" 15	...	13.08	9.908	13.360	0.3424	1.996
" 16	x	13.08	8.153	12.350	0.2427	1.716
" 17	x	13.08	17.875	20.900	0.3248	2.257
" 18	x	13.08	Lost			
" 19	x	13.08	10.819	14.630	0.3190	2.296
" 20	x	13.08	11.464	14.490	0.3622	2.250
" 21	x	13.08	9.222	14.170	0.2754	1.861
" 22	x	13.08	8.119	16.250	0.3917	2.168
" 23	x	13.08	9.863	17.250	0.3346	1.905
" 24	...	13.08	11.752	16.880	0.3720	2.080
" 25	...	13.08	7.207	14.560	0.2388	1.565

TABLE II. CASE III.—URINE.

Date.	*x*-ray exposures	Nitrogen ingested. Grams.	Nitrogen.	Chlorides.	Uric acid.	Phosphates.
Feb. 19	...	9.25	4.872	2.400	0.1260	0.720
" 20	...	"	9.016	3.920	0.2835	1.169
" 21	x	"	8.288	4.300	0.3000	1.170
" 22	...	"	17.096	8.400	0.4662	2.380
" 23	...	"	12.776	7.475	0.4215	1.794
" 24	x	"	5.264	3.200	0.1380	0.795
" 25	...	"	8.895	5.330	0.2007	1.404
" 26	x	"	6.428	2.780	0.2120	0.888
" 27	x	"	9.872	5.800	0.3767	1.430
" 28	x	"	7.915	5.060	0.2268	1.408
Mar. 1	x	"	19.958	8.937	0.7137	2.614
" 2	...	"	10.668	6.300	0.2962	1.800
" 3	x	"	4.368	2.240	0.1440	0.552
" 4	x	"	11.230	4.042	0.2756	1.764
" 5	x	"	4.211	2.880	0.0740	0.920

Clinically then in these three cases the result was in each instance a rather rapid clearing up of most—in two cases practically all—of the signs of solidification that had previously persisted in the three cases, respectively, for one month, two weeks, and thirteen days,

without improvement. The relation of the improvement to the *x*-ray treatment may have been merely a coincidence, for these exudates often, without any evident reason, clear up after more or less delay. Three cases do not suffice to decide this point, but that the *x*-rays played a lively part in causing the improvement appears to be at least probable, when one considers the influence that the *x*-ray exposures had upon metabolism.

In Case II, as a result of the first exposure (which was *only eight seconds long*, but was actually a fairly intense exposure, since it was one intended to produce a negative), the nitrogen increased to more than double what it had been before, and the chlorides showed an almost equally striking increase; the phosphates were somewhat less decidedly increased, while the uric acid showed relatively little change. The increase persisted in less-marked degree, gradually decreasing coincidently with the decrease of the solidification, and when the latter had disappeared, excretion had reached about its former level.

In Case III, the relation of the excretion to the *x*-ray exposures is even more striking. The first exposure was followed by a decided increase. Owing to a misunderstanding, the next exposure was not given for three days, and in the interval the excretion dropped decidedly; after the second exposure there was a moderate rise and then there was again an interval of two days between the exposures, and the second increase of excretion was also followed by a decided drop. The subsequent daily exposures were accompanied by an increase that was somewhat irregular, but became extremely remarkable on March 1. Again following the omission of an exposure on March 2, the urine of the 3d shows a striking drop, and finally, in this case also, as the solidification largely disappeared, the excretion appeared to be dropping pretty well to the original point, in spite of continued exposures, though, as the patient was soon to leave the hospital we could not carry the observations far enough to determine the latter point positively. At the end of the experiments in the two cases the first patient was retaining a great deal of nitrogen and the second patient was showing a strong tendency to retention; while in the periods during which they showed a marked increase in the excretion as the result of the *x*-ray exposures both were showing a very decided loss of nitrogen.

The figures that we have given show that the effect upon metabolism was indeed a most remarkable one. We have seen similarly profound effects only in one of the cases of leukemia that we have previously described—in which there was an extremely rapid improvement in general condition, splenic tumor, and leukocytosis—and in the two cases of general toxic reaction that we shall describe in another paper, though it should be noted that in the two latter cases the effect, while profound, differed strikingly from that

in the case of successfully treated leukemia and in these cases of unresolved pneumonia.

Since such a remarkable effect was exerted upon metabolism, and since this was coincident with rapid improvement in the pulmonary signs, it would appear highly probable that the *x*-rays caused the improvement. The conditions observed are, in fact, extremely similar to those that occur at the time of an ordinary crisis in a favorably progressing pneumonia; that is, the exudate grows moist and clears up within a short time and, coincidently with this, there is a large increase in the metabolic output through the urine.

Whether the *x*-rays will prove to be of great importance in the treatment of unresolved pneumonia is, therefore, a question that is worth settling, but it is one for the future to decide. While, however, this decision is of importance, it seems to us that there is a broader interest in the question whether the theory that was the basis of these observations—the theory that the *x*-rays act upon metabolism chiefly as a ferment accelerator—is correct or not. When, for example, one administers hydrochloric acid with pepsin or alkalies with pancreatin, one consciously or unconsciously uses, to be sure, the same principle; that is, one attempts to provide conditions that are known to be especially favorable to the rapid action of these ferments; but in the manner in which these measures can now be used artificially, the results of such treatment do not at best distantly approach those accomplished in natural circumstances. Except in a few such simple and comparatively ineffectual instances, this principle of using measures that provide conditions that directly accelerate special ferment processes has not, to our knowledge, been deliberately used previously in the treatment of pathological states. In case our view is correct this study furnishes the first example of the deliberate use of this principle in the treatment of disease that lies beyond the digestive tract, and more especially the first instance of the conscious use of this principle with results that are so striking in their effect as to approximate those that the human organism itself accomplishes when successfully reacting to disease.

If, therefore, we are correct this is of considerable interest when one reflects upon the importance that ferment processes have assumed in the last few years in our conceptions of physiology and pathology. There is at present a widespread and somewhat excited tendency to give ferment processes a much more overwhelmingly important place than has been demonstrated to be their due; but the fact that they play an important part in the body economy is perfectly evident, and that methods that would clinically influence them in definite and controllable ways would be of great value scarcely needs to be stated.

Numerous attempts have been made to isolate and administer ferments themselves, of various kinds, in the treatment of diseases

in which they are supposed to be absent; but such attempts have certainly been, in almost all instances, largely or entirely failures. This is scarcely to be wondered at, for in the first place knowledge of these ferments and of their relation to disease is in most instances at best very hazy, and, furthermore, attempts at isolating them are built upon most incomplete and insecure methods; and it is likely to remain most questionable whether tissue ferments can ever be obtained in active form, and then guided to the proper spot still in active form. It is equally questionable whether, should they arrive there, the disordered medium in which they would often find themselves would be such as to permit them to act. Indeed, it is exceedingly doubtful whether the whole idea of administering ferments is not as a rule wholly unphilosophical, both for the reasons given and because in many of those instances in which they appear to be absent they are probably not entirely absent, perhaps not even reduced in amount, but are merely unable to act properly owing to unfavorable chemical or physical conditions. It is possible that we may ultimately learn to stimulate the production of ferments in different organs with some accuracy, and this may prove to be occasionally a successful measure; but it is at present in the distance, and for the reason mentioned in the last sentence, it would frequently have only ineffectual results, for it is wholly rational to conceive of most varied chemical and physical conditions that would more or less completely interfere with the action of ferments in the tissues, and many such conditions, both simple and complex, are already known. If such conditions were present, increasing the amount of ferment would, of itself, be of no avail; and the essential matter would be to substitute for existing substances or conditions others that would inaugurate or accelerate the action of the ferment that is present. This is probably done already in using various therapeutic measures that have been evolved empirically; many drugs, for instance, are known to have a very marked effect upon a number of catalytic processes, and observations yet unpublished, that Dr. Casper Miller and Dr. Edsall have made, indicate that the striking lesions produced by toxic doses of mercury, and probably the remarkable effect that mercury exerts on syphilitic tissues, are, partly at least, the result of increased autolytic activities. The conditions under which a ferment acts are probably more frequently important in producing pathological states than is the amount of ferment present, for ferments are exceedingly sensitive to the conditions under which they act, in both a positive and a negative way, and the conditions influencing them are exceedingly numerous and varied. The almost inconceivably energetic effect of conditions that have a very marked accelerator action is shown, for example, by the fact that the intestinal wall appears to be able in the brief period that is necessary for their passage through it, to rebuild into the native protein of the individual the fragments of protein broken down in digestion, while the best conditions

that experimenters can now provide furnish, even after long periods of action, at most, only doubtful evidence of slight artificial imitation of such a process; and, on the other hand, as is well known, mere traces of certain substances, such as hydrocyanic acid, will greatly retard or wholly interfere with the action of relatively enormous quantities of some catalyzers.

This casual mention of some of the most evident conditions that are known to influence the action of ferments suffices to make it reasonably clear that if a study of ferments is to become of value clinically it is likely to be chiefly through determining the conditions that influence the activity of individual ferments under normal and pathological conditions and through making use of measures, clinically applicable, that can be shown to provide, of themselves and directly, favorable conditions for the action of these ferments, or that overcome unfavorable conditions.

Whether our view regarding the action of the *x*-rays and their effect in unresolved pneumonia is correct or not the future will probably see the principle upon which we were working used many times, as knowledge of ferments and of their accelerator and anti-accelerator conditions increases. That which has just been said must not, however, be misinterpreted. It is intended largely as a protest against the blind but common belief in a mysterious value of ferments as therapeutic agents, a faith that gives opportunity to manufacturers to foist upon many of the profession preparations that are even supposed to contain, isolated and in active form, ferments that are by no means definitely known to exist; and still more would we protest against the excited enthusiasm of those investigators whose work has been such as to lend them the respectful attention of the profession, and who now seem occasionally to be heralding the approach of a therapeutic millenium that is to be distinguished chiefly by the administration of ferments. We would not be thought to believe, however, that there is, instead of this, a nearer-by millenium, in which knowledge of the conditions in which ferments act will lead to inevitable success in the treatment of disease. We would merely point out that in contrast with the dubious plan of treating disease by administering ferments, those who think conservatively in regard to this matter can scarcely believe that much will ever be accomplished in a large proportion of cases in which ferment action is at fault except by modifying the conditions under which ferments act. Through happy chance it will not improbably occur that occasionally the knowledge that accumulates will be made of service in successful therapeutic practises, if this manner of viewing the relation between ferments and therapeutics is held in mind; but any such success will almost certainly, for a long time to come, be largely the result of happy chances that are pointed out by a modicum of suggestive investigation. It will surely be a wearily long period before slow, pains-

taking, and complex investigations make it possible to apply any such principles in a considerable number of cases with a just expectation of success. The exciting work on ferments that has occurred in recent years has greatly transformed the point of view assumed in attacking problems in pathology, but has not in other ways profoundly simplified these problems. The difficulties and complexities have not been essentially lessened; their nature has rather been made more evident.

A BRIEF STUDY OF A DIPHTHERIA EPIDEMIC AT THE ADIRONDACK COTTAGE SANITARIUM (FOR INCIPIENT PULMONARY TUBERCULOSIS).

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Diphtheria epidemics in institutions for the tuberculous are of unusual occurrence, for which reason, as well as on account of the many problems that arise under such conditions, it has been deemed of sufficient interest to report in more or less detail a recent epidemic of diphtheria at the Adirondack Cottage Sanitarium.

The origin of the first case has never been clearly determined. We present the facts as they occurred. Early in October, 1905, one of our orderlies, after a visit to his home, developed a membranous tonsillitis, which on a single culture showed streptococci and no diphtheria bacilli. He was allowed accordingly, after a few days' isolation, to resume his duties. Several cultures taken from his throat at intervals later on during the epidemic, as well as those from his room-mate, were always negative. In the latter part of the month, one of the maids, who had but recently begun work in the laundry and who was with the orderly quite frequently, reported with a well-developed tonsillar diphtheria. She was promptly isolated in her room with her room-mate, her sister, and a strict—as we thought—quarantine established. Later we learned that, standing in her doorway, she would hold conversation with the other maids. After most rigid precautions, including negative cultures, both sisters were discharged, the latter on Saturday evening December 30, 1905. The same day, before the first maid was discharged from quarantine, a patient and one of the maids had a slight soreness of the throat, and two days later when they reported that they felt ill, a second patient went to bed. The second maid, who was employed in the dining-room and linen-room, was at work

until she went to bed in the evening, when the diagnosis was made in all three. The patients were isolated and given antitoxin at once. The next day a cottage entirely apart from the other buildings was opened as an isolation pavilion, placed in charge of a competent nurse, and the patients transferred there. The same day, January 2, the throats of all in the institution were carefully inspected, and a patient and two maids with tonsillar membranes were isolated. One of these was probably not diphtheria, although a positive culture was obtained at a later date. The next day, January 3, all patients and employees, irrespective of any pulmonary or other trouble, were given an immunizing dose of 500 units of the antitoxin prepared by the New York State Board of Health. The two cottages and the Childs Memorial, the infirmary where the cases of diphtheria had occurred, were isolated. Each inmate of these cottages was given 1000 units, and not allowed to leave the cottage for one week. During this week several (six) cases of follicular tonsillitis developed, which, we might add, caused much uneasiness, especially as one occurred in one of the infected cottages. The infirmary patients received but 500 units, and one of them who had complained of sore throat developed a membrane on the posterior pillar. She was promptly transferred to the isolation cottage, but the membrane proving by culture to contain only streptococci, she was sent back to the Childs Memorial. It was with some trepidation that immunizing doses were given to five of the infirmary patients, as they were in an advanced stage of tuberculosis, and in three cases the disease was more or less acute. No more cases developed until January 16, two weeks after the first immunizing dose was given, when one of the nurses developed a rather sharp attack of tonsillar diphtheria. The day following, January 17, the fireman, and on January 18 and 19 two patients were attacked. On January 20 a second immunizing dose of 500 units was given to all patients who had not shown especial susceptibility to the antitoxin. To these a dose of 400 units of purified antitoxin prepared by the New York City Board of Health was given a few days later. No more cases of clinical diphtheria developed, but on January 21 it was deemed expedient to take cultures from the throat and nose of every inmate of the institution. The result was appalling, twenty-two of the patients and nine of the employees, including the chef and the baker, revealed positive cultures. The attempt at isolation of inmates with positive cultures, but without clinical symptoms, which had been begun, was gloomily abandoned. The health authorities quarantined the institution, but strange to say few patients became frightened. On January 24 the last case, a patient whose throat was negative at first, developed an apparent follicular tonsillitis which was positive on cultures, and was isolated. A second cottage had been opened and a nurse placed in charge. A third and last

immunizing dose (400 units of the purified antitoxin) was given on February 3. The quarantine was raised February 20, after the last case of clinical diphtheria showed two successive negative cultures. No new patients were admitted until February 27, and for some weeks each was given 400 units of antitoxin on admission.

To summarize briefly, the epidemic lasted fifty-one days, that is, from January 2, when three patients became ill, to February 20, when the last patient was discharged from quarantine. Eleven cases of clinical diphtheria developed, and in 32 other individuals diphtheria bacilli were found on culture. There were no fatalities and no serious complications. In all over 400 immunizing doses were given to 174 individuals—129 tuberculous and 45 non-tuberculous.

Epidemics of diphtheria in institutions are by no means rare, but we can find no record of such an epidemic in a sanitarium for pulmonary tuberculosis in which the youngest patient was aged about eighteen years. Such a condition presents many peculiar phases and problems on which we could get little or no information. In the first place, should the patients be given immunizing doses of antitoxin? How often should these doses be repeated? Should cultures be taken from the throat and nose of all the patients or only from those with clinical diphtheria? How should the treatment for the pulmonary tuberculosis be modified, if at all? Should the pulmonary tuberculosis modify the amount of antitoxin in the diphtheria?

The most important point in prophylaxis is complete isolation. We feel now that had we set aside a separate cottage and placed in it the first patient under the supervision of a competent nurse the epidemic would have been avoided. We took every precaution, but it is difficult to impress the necessity of complete isolation upon many persons, not only those of low intelligence. For this reason a nurse is a *sine qua non*. The most careful quarantine was established as soon as the epidemic broke out. No measures were omitted. Every room was carefully fumigated with formaldehyde and completely renovated, and each of the cottages where diphtheria occurred was scrubbed down with corrosive sublimate, revarnished, and retinted.

Immunizing Injections. All inmates received two or three immunizing doses of antitoxin. The doses were at first 500 and later 400 units.

A small amount of antitoxin prepared by Parke, Davis & Co. was used, but the greater part was from the New York State and City Health Departments.

The injections were made for the most part midway between the scapula and the spines of the eighth and ninth dorsal vertebræ. Many of the women preferred the injection in the arm, but the local reactions were much more severe in that region.

Preparation. The preparation of the skin can be done very simply. It was cleansed with absorbent cotton, usually first with soap and water, then always, and in some cases only, with alcohol. The site of injection was closed with collodion. The most convenient syringe we found to be the small "Sub—Q" glass syringe, with an asbestos wrapped glass plunger, holding about 2 c.c. Small needles were used, and the whole syringe was frequently boiled; after each injection they were rinsed out with boiling water.

Results. In no case did any infection occur. In four instances diphtheria developed between the fourteenth and sixteenth day following the first injection, and in one case four days and in another one day after the second injection. It was therefore deemed advisable, when only 500 units were used, to repeat the injection for two or three times at intervals of two weeks.

The purified antitoxin produced much fewer unpleasant symptoms than the other varieties, which in many instances produced general malaise, more or less rash, swelling of the face, hands, and feet, pain in the joints (so severe in two cases as to cause insomnia and to require morphine), stiffness of the joints, nausea and vomiting, as well as in nearly every case more or less local tenderness and slight swelling for a few hours.

The injections were usually made in the forenoon and the malaise, when present, usually occurred within twenty-four hours. The majority of the patients suffered some slight inconvenience, but in most cases it was of no moment. In some patients it was postponed for eight to fourteen days and occurred simultaneously with the rash.

The rash occurred more in women than in men, and less in the tuberculous than in the non-tuberculous. Of 140 cases, 32 (23 per cent.) had some rash. In 16 cases the rash was severe. The usual form of rash was urticaria, but fine pin-point papules were present in some cases, more often at the site of the injection. A few acne-like papules occurred in a few cases, chiefly on the face and in women. In two patients who had previously suffered from purpura, a crop of purpuric blotches appeared after the injections. No rash occurred after the first or second injections in 92 patients. In 9 it occurred only on the first, in 6 only on the second, and in 4 only after the third immunizing dose. From this it would appear that the rash is as likely to occur after the first as after the second or third injections. Of 10 non-tuberculous individuals the rash appeared on the seventh day in 5, 1 each on the first, second, eighth, and thirteenth days. Among 21 tuberculous cases, the rash appeared as follows: second day, 2; fourth 3; fifth, 1; seventh, 3; eighth, 5; tenth, 5; fourteenth and seventeenth, 1 each. The rash, therefore, occurred more frequently between the seventh and tenth days, but it may occur as early as the first and as late as the seventeenth day after injection.

The pulse was quickened in several patients. One suffered

from palpitation, in another an intermitting pulse was present. The temperature was raised in thirteen patients and possibly more would have shown this symptom had careful records been kept of each patient. In no instance was the temperature raised for more than a few days. In three patients who were in bed on account of elevated temperature the injections produced no noticeable effect on the temperature further than to raise it a fraction of a degree for a few hours. Stiffness in the joints of the hands, knees, and in several instances in the hips, was present. Associated often with the stiffness and possibly its cause in some instances was swelling of the face, hands, and feet. In many cases the swelling was more or less localized in the arm or leg where the injection was made. Marked swelling occurred in thirteen cases.

The axillary glands were enlarged in five cases in which the injections were made in the back. In one case a chain of enlarged and tender glands extended to the breast. Diarrhœa occurred in one case, chills in another, and pleurisy in a third. In two cases, hemoptysis occurred about one week after an immunizing dose. In some of the foregoing instances the "complications" were no doubt mere coincidences and we believe this to be true more especially of the hemoptyses.

THERAPEUTIC INJECTIONS. The tuberculous were treated when they developed diphtheria, exactly as the non-tuberculous; but when possible they were placed in bed out-of-doors and they slept and lived in rooms with windows wide open at all times. The antitoxin was given in doses of 2000 units daily in the thighs until the symptoms and membrane were markedly affected. In three patients no rash developed, but one, a tuberculous patient, had besides the two immunizing doses of 500 units only one large dose, 4000 units. The rash in the other eight was urticarial, severe and general in six, confined to the legs in two.

One patient, a non-tuberculous case, had some cardiac weakness, but no other complications occurred. The patients, with but two exceptions, received large doses on the first day of the appearance of symptoms, when the membrane was wholly confined to the tonsils. The membrane disappeared in two non-tuberculous cases in five and seven days, in five tuberculous cases, in three, three, five, six, and seven days respectively.

No immediate effect upon the tuberculous process was noted in any cases. The fever disappeared as quickly as in the non-tuberculous. The cough was not increased nor did any patient have night sweats or hemoptyses, though an occasional pleuritic pain was complained of, which, however, was not out of the ordinary. A careful examination of the lungs a short while after discharge from quarantine revealed in all cases an improvement, more or less marked, in the pulmonary condition.

CONCLUSIONS. From our experience in this mild diphtheria epidemic we would conclude that:

1. In institutions immunizing doses of antitoxin of 500 units should be given every two weeks for two or three times.
2. Diphtheria may occur in patients two weeks after an immunizing dose of 500 units.
3. It is unnecessary to endeavor to separate individuals with positive cultures from the nose or throat without clinical symptoms from those with negative cultures when immunization is carried out.
4. One negative culture from the throat is sufficient neither for diagnosis nor for raising quarantine.
5. The advisability of taking cultures from the nose except in nasal diphtheria may be questioned.
6. Careful isolation for three or four weeks under a trustworthy nurse should be practised. After that time the patient with a positive culture should be kept out of the general dining-room or buildings and at a distance of four feet from all non-diphtheritic patients.
7. Some untoward symptoms, usually slight, appear in most patients. A rash, arthralgia, swelling, and general malaise occur most frequently. Slight transitory rise of temperature occurs frequently.
8. In institutions where the out-door treatment is rigidly enforced the epidemic will probably be cut short.
9. In the presence of a diphtheria epidemic, patients with pulmonary tuberculosis should be treated as regards the diphtheria as otherwise healthy individuals.
10. When the tuberculous contract diphtheria they should be moved out-of-doors as soon as possible.
11. Mild diphtheria seems to exert little or no harmful influence upon the pulmonary lesion in the tuberculous.
12. The antitoxin in small or large doses seems to have little or no effect upon the pulmonary tuberculosis.
13. Immunizing doses may be given to patients with fever.
14. Complications seem to occur after diphtheria no more often, possibly less, in the tuberculous than in the non-tuberculous.

We desire to record here our hearty appreciation of the kindness of the officers of the New York State and City Boards of Health. We feel that it is but just to say that without their assistance and advice and the promptness with which they supplied us with antitoxin this mild epidemic might have been most serious. Our acknowledgments are due also to the health authorities of the village of Saranac Lake and of the township of St. Armand.

THE CHEMICAL AFFINITY OF MUCUS FOR HYDROCHLORIC ACID.[1]

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Some months ago, with the co-operation of Dr. A. V. S. Lambert, I began a study of the secretion of HCl under various conditions. Dogs were used, and the gastric juice was obtained by means of Pawlow fistulæ. In the course of the experiments it was noted that while the gastric juice collected from the artificial stomach had no opportunity to come in contact with the food, yet a considerable fraction of the HCl always existed as combined acid, whereas all the acid apparently should have been uncombined free acid. At first this result was supposed to be due to some serum which had run into the collecting funnel from the stitch margin of the fistula along with the gastric juice; but a month later, when the wound was healed, this explanation did not appear adequate. It had also been noted that the mucus in the collecting receptacle varied from hour to hour, and that when the amount of mucus was considerable the combined acid was also increased.

In his studies of the secretion of acid in the stomach Pawlow observed a fluctuation which he thought might be explained by different rates of flow—that is, when the gastric juice was rapidly secreted it passed quickly over the mucous membrane and was not so much "neutralized" as when the secretion was slow. Pawlow speaks of the mucous membrane as "alkaline." I am unable to determine from his papers whether Pawlow determined the total amount of HCl in the gastric juice as well as the free acid, but I am led to think he did not, because of his conclusion that the amount of HCl secreted in the stomach during the digestive period is constant. I am unable to find any reference in the papers of Pawlow or his pupils relative to mucus as a "neutralizing" medium for HCl in the stomach.

The function and fate of the mucous secretions in the various parts of the gastrointestinal canal are relatively unknown, in a physiological as well as a chemical sense. In the stomach mucus is constantly being secreted to some extent, but more at some times than at others, as, for example, at the end of a digestive period; and in certain pathological conditions the amount of this secretion is quite considerable.

Several years ago it was observed in this laboratory that "precipitated mucoid shows practically no combining power with acids. In the hydration of mucoid by pepsin acid, however, acid combines

[1] Received for publication September 30, 1906.

with the dissolved protein products formed in the process."[2] It seemed probable that similar behavior of the gastric mucus accounted for the constant occurrence of combined acid in the juice obtained, and at Gies' suggestion the following experiments were conducted along lines similar to those that had been performed on mucoid.

Mucus from pigs' stomachs was used.[3] In the first series of determinations this mucus was dissolved in 0.5 per cent. Na_2CO_3. The solution was filtered, neutralized with dilute HCl, and precipitated by means of alcohol. This precipitate was collected on a filter and washed with water. Mucous protein obtained in this way is only slightly soluble in water and is neutral in reaction.[4] A suspension in water was made of this mucous product, and to it was added $\frac{3}{n}$ HCl until the solution gave just a faint reaction for free acid with Günsberg's reagent. Under these conditions, while there is some combining affinity of mucous protein for HCl, it is insignificant.

On the other hand, when 0.1 gram of pepsin[5] is added to such a mucous suspension the result is marked, as shown in the following summary of data obtained in one of the experiments:

TABLE I.

Aqueous suspension of about 1 gram of dry mucous protein and 0.1 gram pepsin. Titration with $\frac{3}{20}$ normal HCl.

1.4 c.c. produced reaction for combined acid.

1.6 c.c. produced faint reaction with Günsberg's reagent.

1. After digesting 24 hours in a thermostat at 40° C. there was no free acid present. 2.7 c.c. $\frac{3}{n}$ HCl added.

2. After digesting 48 hours.[6] No free acid present. 0.5 c.c. $\frac{3}{20}$ HCl added.

3. After digesting 72 hours. Free acid present.

4. After digesting 96 hours. No free acid present. 2.5 c.c. $\frac{3}{20}$ HCl added.

5. After digesting 120 hours. Free acid present.

6. After digesting 144 hours. No free acid present. 2 c.c. $\frac{3}{20}$ HCl added.

7. After digesting 168 hours. No free acid present. 2 c.c. $\frac{3}{20}$ HCl added.

8. After digesting 192 hours. Free acid present and persistent.

Total acid added 11.3 c.c.

[2] Gies, Proceedings of the American Physiological Society, p. xiii; Amer. Jour. of Physiol., viii, 1903. Also Gies and collaborators, Biochemical Researches, 1903, i, p. 54.

[3] It was obtained mechanically by lightly scraping the surface of the mucous membrane.

[4] The relation of this result to the studies of salts of mucoids, nucleoproteins, etc., now in progress in this laboratory, will be pointed out later.

[5] Parke, Davis & Co., 1 to 2000.

[6] All records of time in these summaries designate *total* periods from the beginning of digestion.

TABLE II.

Control conditions same as in Table I. 2 c.c. $\frac{3n}{10}$ HCl added.
1. After digesting 24 hours. No free HCl. 2 c.c. $\frac{3n}{10}$ HCl added.
2. After digesting 48 hours. No free HCl. 2 c.c. $\frac{3n}{10}$ HCl added.
3. After digesting 72 hours. No free HCl. 4 c.c. $\frac{3n}{10}$ HCl added.
4. After digesting 96 hours. Free acid present.
Total acid added 10 c.c.

The mucus-hydrochloric acid mixtures in these two experiments were combined, and, when filtered and after being neutralized, were submitted to tests for the products of digestion. These digestive products consist almost wholly of proteoses, with only a trace of peptones.

A second series of observations was made in which, instead of the precipitated mucous protein used in the previous experiments, I employed the fresh mucus as it is immediately after its removal from the pig's stomach. The observations were not intended to be strictly quantitative, but they served well the chief purpose in view, that is, to ascertain whether fresh mucus combines with acid. The mixtures were kept well covered with toluol and the digestion carried on at a temperature of 40° C. The results were as follows:

FLASK I.

Mucus, 2 grams; water, 25 c.c.
Pepsin, 50 mg.; $\frac{3n}{10}$ HCl, 4 c.c.
1. 24 hours. Free acid present.
2. 48 hours. No free acid present. 2 c.c. $\frac{3n}{10}$ HCl added.
3. 72 hours. Doubtful reaction. 1 c.c. $\frac{3n}{10}$ HCl added.
4. 96 hours. Free acid present.
5. 120 hours. Free acid present.
6. 144 hours. Free acid present.
Total acid added 7 c c.

FLASK II.

Mucus, 2 grams; water, 25 c.c.
Pepsin 100 mg.; $\frac{3n}{10}$ HCl, 4 c.c.
1. 24 hours. No free acid. 2 c.c. $\frac{3n}{10}$ HCl added.
2. 48 hours. No free acid. 2 c.c. $\frac{3n}{10}$ HCl added.
3. 72 hours. Free acid present.
4. 96 hours. No free acid present. 2 c.c. $\frac{3n}{10}$ HCl added.
5. 120 hours. Free acid present.
6. 144 hours. Free acid present.
Total acid added 10 c.c.

Flask III.

Mucus, 2 grams; water, 25 c.c.
Pepsin, 200 mg.; $\frac{3}{20}$ HCl, 2 c.c.
1. 24 hours. No free acid 4 c.c. $\frac{3}{20}$ HCl added.
2. 48 hours. Free acid present.
3. 72 hours. Free acid present.
4. 96 hours. No free acid. 2 c.c. $\frac{3}{20}$ HCl added.
5. 120 hours. Free acid present.
6. 144 hours. Free acid present.

Total acid added 8 c.c.

Flask IV.

Pepsin, 100 mg.; water, 25 c.c.; $\frac{3}{20}$ HCl, 4 c.c. No mucus.
1. 24 hours. Strong reaction for free acid.
2. 48 hours. Strong reaction for free acid.
3. 72 hours. Strong reaction for free acid.
4. 96 hours. Strong reaction for free acid.
5. 120 hours. Strong reaction for free acid.
6. 144 hours. Strong reaction for free acid.

The pepsin-acid solution was titrated against $\frac{3}{20}$ NaOH in the last case, 3 c.c. being required to neutralize the free HCl present. The 1 c.c. which had been found was probably in combination with some proteid material such as proteose that existed as impurity in the pepsin preparation.

It is clear, I think, from these results, that mucus, like albumin and other proteins, is capable, in the presence of pepsin, of combining with hydrochloric acid. This is true not in a slight degree, but to a relatively marked extent. It is probable, also, it seems to me, that in the stomach the combining power of fresh mucus, as it is secreted from the gland, is much greater than these experiments indicate, because in using, as I have had to do, mucus removed from the stomachs of pigs that had probably not been recently fed, a hunger stimulus would have excited the flow of some gastric juice, and thus would largely have satisfied the combining power of the mucus used in the experiments.

However that may be, the combining power of mucus with HCl, as demonstrated in these experiments, is sufficient to explain some of the physiological and pathological phenomena that are well recognized. For example, in certain morbid gastric conditions there is observed a marked diminution in the amount of free HCl, while the total acidity (exclusive of organic acids) is often almost or quite normal. Along with this there is an excessive secretion of mucus. In such states it does not seem unlikely that the combined acid is bound with mucus, and the condition resembles that observed in dogs with Pawlow fistulæ, in that during the later periods of digestion mucus is secreted abundantly, and often at such times there is only a trace of free HCl, while the total acidity may be considerable.

REVIEWS.

AMERICAN PRACTICE OF SURGERY: A COMPLETE SYSTEM OF THE SCIENCE AND ART OF SURGERY. By REPRESENTATIVE SURGEONS OF THE UNITED STATES AND CANADA. Edited by JOSEPH H. BRYANT, M.D., and ALBERT H. BUCK, M.D., of New York City. Complete in eight volumes. Vol. I, pp. 818. New York: William Wood & Co., 1906.

SURGERY, ITS PRINCIPLES AND PRACTICE. By VARIOUS AUTHORS. Edited by WILLIAM WILLIAMS KEEN, M.D., LL.D. In five volumes. Vol. I, pp. 983. Philadelphia and London: W. B. Saunders Co., 1906.

THE appearance of the initial volumes of two *Systems of Surgery* within a few months of each other naturally raises a query as to the utility in general of such treatises. The mere fact that two systems are being published simultaneously does not prove that there is need for both, yet it is at least evidence that there are good prospects of each meeting with a cordial reception, since works of such magnitude are seldom undertaken without assured support.

There are two chief forms in which surgical literature of a permanent kind is placed before the public—the monograph and the system. While the author who presents his views in the form of a monograph rarely is recognized as such an authority during his lifetime as is the author or editor of a system, yet, in years to come, his work advances to a higher niche in the temple of fame, while the system is replaced, discarded, even forgotten. Who reads Heister or Boyer? Who does not read Malgaigne, Paget, Gurlt? The reason for this difference, we venture to think, is that the chife value of a "system" consists in its being systematic—that is, in the fact that all subjects of surgery are included in its volumes, the little as well as the great, the rare diseases as well as those of frequent occurrence. In a monograph the author deals with one subject or at most with a group of subjects closely related; and his personality lends character to the whole. In a system the text should be cyclopedic in character. Hence it is that skilled taxonomists make the best editors; and on this account mainly, we think, do the volumes at present under discussion fall short of the standard which the reviewer has in mind.

The first of these two volumes claims for itself a distinctively

American character; and, while we have no sympathy with that narrow provincialism which prefers an American to a foreign work merely because it is American, yet we feel no fair-minded critic can deny that representative American surgeons are at least as well qualified to write upon surgical topics as are those of any other single nation. This, however, is not asserting, and indeed we do not admit, that a still better system could not be produced by the judicious selection of authors from European as well as American countries.

We do not believe that an editor's labors consist solely in outlining the plan of a work and in selecting authors for the various articles, and then turning the authors loose into the field of surgery to wander where and at what length they will. We hold that the editor should personally supervise the construction of each article, and so correlate one to the other that a finished whole shall ultimately be presented to the reader. Keen, who in this arduous task has had the efficient aid of J. Chalmers DaCosta, fulfils, in these respects, the duties which we think appertain to an editor more successfully than do Bryant and Buck.

In the *American Practice of Surgery* the basic principles are discussed in five parts: I. Inflammation (Warthin); disturbances of nutrition (Nicholls, of Montreal); repair (E. H. Nichols, of Boston); tumors (Nicholls); theories of tumor formation (McGraw); parasitical relations of cancer (Gaylord). II. Infections of occasional occurrence (Paul M. Pilcher, of New York)—a thoroughly unscientific contribution; surgical shock (Bloodgood)—much superior to Crile's parallel contribution in Keen's *Surgery*. III. Surgical diagnosis (Bryant)—a diffuse and rambling essay; body fluids in surgery (Harlow Brooks); radiographic interpretation of epiphyses (Hickey); technique of radiography (Osgood, of Boston)—a very technical paper. IV. General surgical treatment (J. E. Moore). V. Prognosis (Leonard W. Bacon, of New Haven).

The first volume of Keen's *System* includes: Physiology (Crile); hematology (Da Costa)—a needlessly elaborate and technical paper; infection and immunity (Hektoen)—orderly, concise, intelligible; inflammation (Adami); suppuration, abscess, ulcers, gangrene, etc., (Freeman); repair (Francis Carter Wood); thrombosis and embolism, erysipelas, tetanus, scurvy, special infections, and poisoned wounds—articles by Frazier, much in the manner of his recent contributions to *Progressive Medicine;* traumatic fevers (Eugene A. Smith); rickets (Nichols, of Boston); surgical tuberculosis (J. Chalmers Da Costa); chancroids and syphilis (Edward Martin); tumors (Bland-Sutton); wounds and contusions (Crile).

Each volume opens with an historical sketch, that in the *American Practice of Surgery*, by Stephen Smith, being limited to the evolution of American surgery, while Mumford, of Boston, in the other work begins his tale from the twin egg of Leda. Smith's article

is sufficiently interesting, but possesses a biographical style which is wearying to the reader, and there are some inconsequential blunders which are an annoyance to anyone who loves accuracy of statement. One such is his constant reference to the University of Pennsylvania by the name of "University Medical College, Philadelphia." Mumford's style is distinctly individual, and at times decidedly undignified. His hortatory expressions are such as will give cause for offence to many students, while in others they will produce a derisive curl of the lip. His facts are not always exact, and we would caution the inexperienced reader against accepting as gospel truth the statement that Rhea Barton is remembered chiefly for his osteotomy of the *knee*. The reference on the same page to McClellan's operation for removal of the entire scapula and clavicle is inaccurate, since this operation was an "amputation above the shoulder." His citations of the titles of medieval Latin works show a curious fondness for inversions in the order of words. To devote fourteen pages to John Hunter and his times, with twenty-two pages to all preceding and twenty-four to subsequent times, seems ill-balanced. Surely Maisonneuve is more worthy of mention than von Kern and von Walther; Bonetus is not mentioned at all; Morgagni is merely named; and though a portrait of Astley Cooper is given, his career is disposed of in two lines, and that of le grand Petit in one!

Inflammation is discussed by Warthin in the *American Practice of Surgery*, and by Adami in the system edited by Keen. While Warthin's article is sufficient, we cannot but feel that its distinguished author is capable of better work. The subject is treated in too hazy and uncertain a manner for us to consider the article practical; yet there is too little profundity of thought for it to be classed as a masterpiece in the realm of theory. It has impressed us as the work of a man who, although perhaps an excellent teacher, yet lacks the pen of a ready writer—one who cannot lucidly express either his own thoughts or those of other people. His mind appears to be convinced of nothing; instead of giving its due weight to each of the factors usually recognized as playing a part in this complex process, he gives them all nearly equal weight, so that his article is like the concluding chapter of Rasselas, in which nothing is concluded.

Few things really new have been added to the pathology of inflammation since the day of Metchnikoff's discovery. Probably the most important is the bactericidal action of the blood plasma and of the fluid in exudates; and the next, the discovery of rudimentary lymph nodes throughout the tissues which supply a large proportion of the cellular elements found in a part which is inflamed. This source of supply is more emphasized by Warthin than by Adami, who, however, accepts as proved that much of the round-cell infiltration has its origin in proliferation of endothelial cells of one

kind or another. Both these authors classify tuberculosis, syphilis, etc., as inflammations with special characteristics due to the cause and to the tissues affected. Though this is an unusual view to take at the present day, it is one which has always appealed to us as logically correct. It is, however, a view which is categorically denied in other portions of both volumes. The writers on inflammation also consider granulating wounds identical with ulcers, while a very emphatic denial of this dictum is found later in the volumes.

Such contradictions, moreover, are not confined to purely theoretical considerations. Thus we find Smith, of Buffalo, recommending, in Keen's *Surgery*, a separate building for the hospital treatment of erysipelas, while Frazier, in the same work, expresses the opinion that it is safe to treat it in the general ward with other infected wounds. For our own part, we think the former opinion in each case not only saner, but more safe, and join with the philosopher when he exclaimed: *"Errare malo cum Platone, quam cum istis vera sentire."*

In Bryant and Buck's work the article on tumors is by Nicholls, of Montreal; in Keen's volume it is by Bland-Sutton. It is said to be a maxim of the civil law that definitions are hazardous, and in no respect, perhaps, is this more evident than in attempting to define a tumor. Nicholls agrees with Thoma in calling a tumor an independent new-growth. Bland-Sutton is too wary to be trapped into definitions of any kind. His article, one of the best in the volume, deals with the question in a broad way, and does not descend to many details. He makes little attempt at classification, but discusses in his usual masterly and comprehensive manner the clinical course and the symptoms of the various well-recognized types of tumor. His aim is to reduce the number of new-growths, and he is apparently of the opinion that tumors differ from the infectious granulomas only in the same way as these latter differ from ordinary inflammation. Indeed, to anyone who reads Stricker's studies in the pathology of inflammation, with the hindsight derived from a knowledge of Coley's work in the serum-therapy of tumors, it is not very difficult to detect the inkling of such an idea in the writings of the great Austrian pathologist himself.

Nicholls' article on tumors is much concerned with the subject of classification, which is the most important question of all at present, because only when we have them classified can we have any accurate idea as to their cause. He gives Adami's classification of tumors as an improvement upon the embryological classification of Waldeyer, but does not adopt it. Although this comparatively new classification appeals to us as philosophically correct, we quite agree with Nicholls that it is too complex to be adopted for general use at present. We cannot, however, agree with Nicholls that the classification which he does adopt presents any advantages whatever,

except that of allowing tumors to be described very nearly in any sequence that may happen to strike the fancy of the writer.

McGraw supplements the article by Nicholls with a concise but thorough paper on theories of tumor formation. The sum of our knowledge is well expressed in his phrase that Nature abhors a cellular anarchy. Gaylord still further elaborates this subject by a temperate and conservative article on the parasitical relations of cancer. This whole paper, like most in the volume, might well be condensed into less than half its space, yet the argument is complete as it is, and perhaps would have less force if more succinctly stated. It is encouraging to note that as Gaylord's experience increases he is less ready to believe every unusual feature he sees in the blood to be a parasite of cancer. The readers of this JOURNAL will compare with surprise his present views with those which he expressed in its pages not many years since.

Yet, with all his conservative statements, Gaylord comes very near, we think, to proving the parasitical origin of cancer, save for the "if" with which his statements begin: "If a primary cancer," he says, "starts from a given centre and the cancerous transformation spreads from cell to cell, it must be that that force or factor which endows normal epithelium with the power of limitless proliferation is transferred, at least for a certain period of time, from the involved cells to the adjoining normal ones." Although he quotes Orth as supporting similar views, it seems to us more rational to suppose that cancer is propagated by proliferation of already diseased cells, rather than by infection or metaplasia of healthy cells; and as the interpretation of microscopic changes is confessedly difficult, we must still look upon this conclusion as dependent upon a very large If.

We have left ourselves, much to our regret, no space to speak of the excellencies of these volumes. If our review seem to some unduly critical, we can only plead in justification our view that the good points speak for themselves and that a reviewer's function is rather to discover shortcomings than to cover all with a gloss of indiscriminate praise. We would like to speak of Da Costa's article—the only truly encyclopedic contribution in either volume—on surgical tuberculosis, in Keen's *Surgery;* and of the novel and effective paper in Bryant and Buck's system on the radiographic interpretation of the epiphyses, by Preston M. Hickey, of Detroit; as well as of other articles too numerous to mention. There is a mine of information within these covers, not always in easily accessible form, nor is it always the purest ore; but such as will well repay earnest and conscientious study. A. P. C. A.

THE EYE AND THE NERVOUS SYSTEM. THEIR DIAGNOSTIC RELATIONS. By VARIOUS AUTHORS. Edited by WILLIAM CAMPBELL POSEY, M.D., Professor of Ophthalmology in the Philadelphia Polyclinic and College for Graduates in Medicine; and WILLIAM G. SPILLER, M.D., Professor of Neuropathology and Associate Professor of Neurology in the University of Pennsylvania. Illustrated. Pp. 988. Philadelphia: J. B. Lippincott Co., 1906.

IN estimating the value of a large and important book like this, the reviewer naturally strives to judge of its merits from several points of view. Does it really fill a gap? Does it successfully carry out the plan laid down in the preface? Does it make contributions of value to our knowledge? Is it uniform in its excellence and free from marked defects? Does it compare favorably with other books of its own class? Some of these questions require a careful answer, but it may fairly be said that, on the whole, the work will be welcomed as a clear, practical and conscientious discussion of an important group of subjects. As the sense of vision played such a large part in the evolution of our minds and brains, so the diseases which centre on the visual apparatus are of immense importance, both in their practical and in their scientific aspects, and there is no other treatise in our tongue that presents the various matters here at stake in so comprehensive and so modern a form as this.

The book with which one naturally compares it is the monumental work *Die Neurologie des Auges*, by Wilbrand and Sänger. It must be admitted that, so far as they go, the three parts which comprise all that has thus far been published of this last-named work are so searchingly thorough, and gain so much by being practically written by the same hand, that they place it among monographs of a higher order than most of those which make up the volume now before us. On the other hand, the German work is far more limited in its scope, and, thus far at least, practical questions of treatment are not discussed in it at all.

As has been said, Posey and Spiller's volume considers the diseases involving the eye and vision from a variety of standpoints, and it may be added at once that while this is one of the merits of the book, it is also one of its defects. Several long chapters might easily have been curtailed without any real sacrifice of their value for the main points at issue. This is true, for example, of the articles on tumors of the brain and on the diseases of the pons, although these articles, which are complied with admirable care by Dr. Spiller and Dr. E. W. Taylor, are exceedingly interesting and valuable. In both of them, all that concerns the eyes is pointedly brought out, yet both contain much that seems irrelevant in this place. This criticism is still more applicable to the interesting papers on tremors, reflexes, and gaits by Dr. Sailer, and to that on degeneracy by Dr. Walton. Just because a certain pro-

portion of psychopathic patients have headache not referable to eye-strain and implying morbid sensitiveness, it seems going a little far to enter upon the whole subject of degeneracy and its physical marks, as a means of enabling the physician to diagnosticate his cases justly.

One more criticism of a general nature may be made—although it is not more applicable to this book than to most text-books, not indeed so much—and this is, that in a number of the articles the subject of treatment gets an insufficient notice. Truly enough, this is a topic which the physician often finds but little pleasure in discussing when incurable disorders are in question, and yet it is one that most readers turn to with great eagerness. And when it is seen what an immense amount of patient research is expended on the elucidation of some fine point in pathology, and how the exact anatomical findings of one case after another are described, it is impossible to help wondering whether similar amounts of searching toil expended on the study of the occasional successes in medical or surgical therapeutics might not be well repaid.

With these qualifications, we feel amply justified in giving hearty praise to the twenty-one writers by whom the twenty-three chapters, which constitute the work, were contributed. The subjects taken up cover the anatomy and pathology of the nervous system so far as the visual apparatus is concerned; the examination of the muscles of the eye; the affections of the related nerves; and the many diseases of the nervous and other systems in which visual troubles play a part. Dr. Posey also contributes an excellent paper on mental symptoms due to operations on the eyes, and Dr. Charles H. Frazier another on the surgical treatment of intracranial lesions related, even remotely—very remotely—to disturbances of vision.

It is difficult to comment on all these articles, but we mention as deserving of especial praise the various papers dealing with the mode of examination of the eye; the long, thorough, and judicious discussion of visual psychoses and neuroses, by Dr. G. E. de Schweinitz; the chapter, containing much that is rarely seen, on ocular disorders as related to the insanities, by Dr. F. X. Dercum; and that on amaurotic family idiocy and infantile cerebral palsies, by Dr. B. Sachs.

Dr. Spiller's anatomical observations are, as usual, admirable, and it is a tribute to him that several of the plates used in other articles are signed with his name. Dr. Mills' paper on the psychology of vision and the diseases of the cortex gives a very conscientious and careful discussion of certain aspects of these subjects, but we bow more to his anatomical and clinical accuracy than to his psychological insight. In fact of real psychology, at all comparable in value to his anatomy, we find but little.

The book is excellently printed and is well illustrated, if not with the great fulness that characterizes the masterly volumes by Wilbrand and Sänger.

J. J. P.

ATLAS AND TEXT-BOOK OF HUMAN ANATOMY. By PROFESSOR J. SOBOTTA, of Würzburg. Edited, with additions, by J. PLAYFAIR MCMURRICH, A.M., Ph.D., Professor of Anatomy in the University of Michigan, Ann Arbor. Volume I, pp. 258. Philadelphia and London: W. B. Saunders Co., 1906.

MANUAL OF ANATOMY, SYSTEMATIC AND PRACTICAL, INCLUDING EMBRYOLOGY. By A. M. BUCHANAN, M.A., M.D., C.M., F.R.P.S. (Glas.), Professor of Anatomy in Anderson's College, Glasgow, Scotland. Vol. I, pp. 596. Chicago: W. T. Keener & Co., 1906.

VOLUME I of Sobotta's *Atlas and Text-book of Human Anatomy*, which is now given in its English dress, comprises a description of the bones, ligaments, joints, and muscles. The descriptions are thorough, accurate, and refreshing in their conciseness—a feature that will be highly prized by students and practitioners, for whom, indeed, especially the book has been prepared. What is known as the Basel nomenclature has been adopted throughout, but the American editor has anglicized most of the terms, except those in the section on myology, and in those relations in which the Basel term is unfamiliar to English-speaking students he has added also the more familiar term. Excellent, however, as is the text, it seems, as it were, overshadowed by the illustrations—320 in number. Photographs were utilized as the basis of most of the drawings; the finished plates comprise multicolored lithographs, prints made by the so-called three-color process, colored half-tones, a few simple line etchings, etc. In fidelity to nature, wealth of detail, and artistic beauty the illustrations are not equalled by those of any similar book with which we are acquainted. There is little doubt that among the many atlases and text-books of human anatomy this deservedly must take a front rank.

Buchanan's book, although a manual, is somewhat comprehensive in its inclusiveness, being designed as a text-book of systematic anatomy and a manual of practical anatomy, or dissection, and including also brief notes on embryology. Volume I deals with osteology and the anatomy of the upper and the lower limbs. The text, like that of Sobotta's and most other anatomies, does not make very exciting reading; it is accurate and concise, but it does not differ from that of others in any noteworthy respect to call for particular comment—which in itself is praiseworthy, since there are many good anatomies. Almost one-half of the work is devoted to osteology—the best section of the book. The anatomy of the limbs is described as the structures are encountered in dissection. The guide to the dissection of the extremities appended to the description of their structures is rather inadequate; its utility would have been much enhanced by more precise directions

relating to how to dissect, as well as what to dissect. The illustrations—268—are much less pretentious than Sobotta's. All are line cuts; most of them are original; many of them are colored—to indicate vessels, nerves, attachment of muscles, etc., and they serve their purpose well. The book is a personal volume, reflecting the views of a distinguished teacher, and doubtless it will be well received and prized by the author's students and friends; but, lacking a distinguishing feature, such, for instance, as the illustrations of Sobotta's book, it probably will not appeal to a very large circle of readers.

A. K.

PROGRESSIVE MEDICINE. A QUARTERLY DIGEST OF ADVANCES, DISCOVERIES, AND IMPROVEMENTS IN THE MEDICAL AND SURGICAL SCIENCES. Edited by HOBART AMORY HARE, M.D., Professor of Therapeutics and Materia Medica, Jefferson Medical College; assisted by H. R. M. LANDIS, M.D., Demonstrator of Clinical Medicine, Jefferson Medical College, Philadelphia. Vol. IV, December, 1906. Pp. 349. Philadelphia and New York: Lea Brothers & Co., 1906.

IN this, the concluding volume of the series for 1906, J. Dutton Steele devotes one hundred and twenty pages to diseases of the digestive tract and allied organs. Special attention is given to a discussion of the significance of occult blood in the diagnosis of gastric and intestinal ulceration, variations in gastric secretion, radiography in the diagnosis of gastrointestinal disease, the varieties and the treatment of constipation, the morbid physiology of visceral pain, cholelithiasis, the stools in disease of the pancreas, and the absorptive power of the peritoneum, with special reference to Schmidt's method of abdominal infusion. William T. Belfield discusses recent progress in diseases of the genitourinary organs, devoting special attention to tuberculosis, tumors, acute unilateral septic infarcts of the kidney, gonorrhœa, and prostatic hypertrophy. John Rose Bradford, discussing diseases of the kidneys, devotes especial attention to treatment. Recent progress in fractures, dislocations, amputations, and the surgery of the extremities is discussed by Joseph C. Bloodgood—one hundred pages. Bone tumors, tuberculosis, and Bier's hyperemia treatment are discussed in detail. H. R. M. Landis contributes a therapeutic referendum of sixty pages that will appeal to every general practitioner.

The volume is a worthy successor of those that have gone before; nothing of moment seems to have escaped the vigilance of the editors, and all that counts for progress has been included.

A. K.

CHEMISTRY: GENERAL, MEDICAL, AND PHARMACEUTICAL, INCLUDING THE CHEMISTRY OF THE U. S. PHARMACOPŒIA. A Manual of the Science of Chemistry and its Applications to Medicine and Pharmacy. By JOHN ATTFIELD, F.R.S., Professor of Practical Chemistry to the Pharmaceutical Society of Great Britain. Edited by LEONARD DOBBIN, Ph.D., Lecturer on Chemistry in the University of Edinburgh. Nineteenth edition, pp. 760. Philadelphia and New York: Lea Brothers & Co., 1906.

THE announcement of a nineteenth edition is, of itself, proof sufficient of unusual merit, and the additional fact that a book withstands the vicissitudes of forty years (since 1867) of scientific endeavor shows an extraordinary adaptability on the part of the author. As in earlier editions, so in the nineteenth, Professor Attfield and his editor, Dr. Dobbin, have successfully accomplished their purpose to produce a manual of chemistry in which not only the science of chemistry should be taught, but in which also the chemistry of every substance having interest for students of medicine and of pharmacy should be set forth in all attainable exactness. The new edition has been revised to conform to the new United States Pharmacopœia. One may regret that some reference to radium has not been included. Still, two generations of scientists have grown up and thriven on the book; doubtless it will serve as pabulum for at least a third. A. K.

DISEASES OF CHILDREN. A POCKET TEXT-BOOK. By GEORGE M. TUTTLE, M.D., Attending Physician to St. Luke's Hospital, St. Louis, Mo. Second edition, pp. 392. *Lea's Series of Pocket Text-books*. Edited by BERN B. GALLAUDET, M.D. Philadelphia and New York: Lea Brothers & Co., 1907.

THE excellence of Prof. Tuttle's work has carried it through two printings and now to a new edition, revised to represent advances to date. By considering only those diseases and phases of disease peculiar to the period from birth to adolescence, the author has found space to present all the essentials of pediatrics within a very compact volume. The various diseases are systematically discussed under appropriate subheadings, the typographical arrangement being such that any desired subject may be instantly found.

A. K.

PROGRESS

OF

MEDICAL SCIENCE.

MEDICINE.

UNDER THE CHARGE OF

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Concerning Hemorrhages from the Kidney.—CASPER (*Berl. klin. Woch.*, 1906, xliii, 1271) states that the occurrence of sudden and often profuse hemorrhage from the kidney without any apparent lesion has attracted a great deal of attention the past few years. In many of the cases the usual causes of renal hemorrhage, stone, tuberculosis, tumor, kinking of the ureter, etc., can be definitely excluded, and the absence of any gross lesion has given rise to such terms as essential renal hemorrhage, angioneurotic hemorrhage, and renal hemophilia. Recently, however, a number of authors have opposed the view that bleeding can occur from a healthy kidney. In their own cases they were always able to find some lesion, and, although the lesion was often insignificant, they still look upon it as the cause of the hemorrhage. Casper reports four cases; all were adults in good health, and the occurrence of blood in the urine was the only symptom of disease. There was no albumin and no casts in the urine. Examination of the organ removed at operation revealed in the first two a well-marked, diffuse, chronic parenchymatous nephritis, demonstrating that such lesions may be present for years without albumin, casts, œdema, or circulatory disturbances and displaying as the only symptom repeated and protracted hematuria. In the other two instances most careful macroscopic and microscopic examination showed the removed kidney to be perfectly normal except for such slight and circumscribed changes as Casper thinks might be found in any kidney. These changes consisted in small areas of fresh infiltration and the circumscribed occurrence of fibrous tissue about a few

glomeruli and small arteries; in the second case also general œdema of the organ. The œdema, Casper thinks, was the result and not the cause of the hemorrhage. The fresh infiltration could well be the result of handling the kidney during operation, and a little increase in the connective tissue about a glomerulus or small bloodvessel is such a common occurrence that we could not in reason attribute any great importance to its presence. He opposes the use of the term nephritis by Israel, Küster, and Rovsing to express the trivial changes they have found in the cases they report. To constitute a nephritis the changes must be bilateral and must be diffuse. In the examination of a large number of cases, by collecting the urine from two ureters separately, he has never found any evidence to support the view of a unilateral nephritis as described by Israel, Pausson, and Edebohls. Such trivial lesions he believes cannot, at least in his own cases, be held responsible for the hemorrhage. They are found so frequently in kidneys from which no hemorrhage has occurred that it is unjustifiable to settle upon them as a cause without more definite proof. In his cases there was every evidence,from the uniform distribution of the blood in the kidney, that the hemorrhage did not come from any one definite point. He thinks that, as far as our knowledge goes at present, we must accept that bleeding may occur from apparently healthy kidneys without any demonstrable lesion to account for the hemorrhage. He urges early operation in all cases, as without it a positive diagnosis is impossible and the early malignant tumor may be overlooked and, by the time a subsequent bleeding occurs, may have metastatized or become inoperable.

Agglutination in Pulmonary Tuberculosis.—JESSEN (*Beit. zur Klin. der Tuber.*, 1906, vi, 209) has made agglutinating tests of the blood serum in a large number of sanatorium patients at Davos. His results fall into three divisions: (1) Patients who are treated by the usual sanatorium methods show, as a rule, a rise in their agglutinating power, and this rise is just as evident and just as high as in cases treated with tuberculin. Evidently the agglutinating power varies under natural conditions and is not, as has been claimed, a direct expression of a reaction to tuberculin injections. (2) Jessen finds that agglutination is of only slight value in prognosis. He divides his cases into three groups: (*a*) Cases that show marked improvement; some of these, originally severe cases, had gradually lost their symptoms and become a great deal better. Nearly all of these display a high agglutinating value, but some who had improved most favorably had a low value. (*b*) Cases clinically considered cured display in most instances a very low value, but a few a very high; and (*c*) cases which had run an unfavorable course showed neither a very low nor a very high value. Apparently, in most instances when improvement takes place the agglutinating power rises. In cases which run unfavorably there is little tendency for such a rise to occur. When improvement produces a cure, the value again tends to sink. Such a classification is accompanied by a great many exceptions, but still Jessen thinks the test is of some prognostic value. If in a given case the agglutinating value is high, the outlook is better than if under the same condition it were low. (3) As a diagnostic measure. In this relation he thinks only high dilutions should be employed. All his tuberculous cases gave values over 1 to 25. While

lower values do not exclude tuberculosis, he thinks higher values suggest its presence. Jessen believes its special field in diagnosis is to lend aid in distinguishing between tuberculosis and other diseases when there is some evident pulmonary lesion present.

A Ring Test for Acetone.—LANGE (*Münch. med. Woch.*, 1906, liii, 1764). 15 c.c. of urine is mixed in a reagent glass with from 0.5 to 1 c.c. of acetic acid, and a few drops of a freshly prepared solution of sodium nitroprusside is added. Upon floating a small amount of ammonia upon this mixture an intense violet ring develops at the point of contact, if acetone is present. The test will detect acetone in a 1/400 per cent. solution. This is merely a convenient modification of the Le Noble reaction and has the advantage over Legal's test of not reacting to creatinin. Lange thinks the contact reaction gives a more distinct picture than the mass reaction. It has an advantage over the iodoform reaction in that alcohol and aldehyde do not give it. It is, however, not nearly so sensitive as the latter.

Typhoid Bacillus Carriers in an Insane Asylum.—NIETER and LIEFMANN (*Münch. med. Woch.*, 1906, liii, 1611). In an insane asylum with 900 female inmates, typhoid fever and dysentery have been endemic for many years, although no explosive epidemic attacks have occurred. Attempts to check the occurrence of the disease by isolation, careful attention to the water and food supply, and to the drainage have been of no avail. Being convinced that infection must originate within the institution itself, the stools of all the inmates were examined and in seven instances they were found to contain typhoid bacilli. Two of these patients were ill with dysentery and the two organisms were recovered from the stool. One patient agglutinated typhoid bacilli 1 to 100, and dysentery bacilli (Flexner) 1 to 800; the other 1 to 50 and 1 to 100 respectively. In the insane asylum at Hardte, the discovery and isolation of two typhoid bacilli carriers led to a rapid fall in the number of cases. Nieter and Liefmann hope to obtain the same results by the isolation of their seven patients.

Cultivation of Typhoid Bacilli from the Blood in a Bile-containing Medium.—CONRADI (*Münch. med. Woch.*, 1906, liii, 1654). It is now well known how important routine blood cultures are for the diagnosis of early and doubtful cases of typhoid fever. The organisms may be cultivated in a large percentage of cases and they occur with marked regularity in the first days of the disease and very frequently before the Widal reaction is positive. Conradi now reports a method by which he claims to be able to cultivate typhoid bacilli in practically every instance if the examination is made in the first week. As early as 1901 he called attention to the fact that bile prevents coagulation. It is also an excellent medium for typhoid bacilli to grow upon, probably acting favorably by neutralizing the bactericidal power of the extravascular blood. The medium as he now employs it consists of ox-bile with 10 per cent. peptone and 10 per cent. glycerin. In a sterilized tube containing 10 c.c. of this medium from 2 to 3 c.c. of blood obtained from the ear or from a vein is introduced and the mixture incubated

for sixteen hours. If typhoid bacilli are present they will have greatly increased in number and identification is readily made by transferring to the usual media.

Theoretical and Practical Consideration of Head's Zones in Visceral Disease.—KAST (*Berl. klin. Woch.*, 1906, xliii, 1033). Head has described certain areas of increased sensitiveness to pain and heat sensation in the skin corresponding definitely to disease of various viscera. These zones he has outlined to correspond with different spinal segments. They do not follow the distribution of the peripheral nerves. Their mode of origin he assumes is, so to speak, a psychical deception. We are devoid of pain sensation conveyed directly from the internal organs, but the sensory nerves from an organ come in close contact in the cord with sensory fibers running from the skin, and our subjective sensations may interpret impulses in the one as pain sensations in the other—referred pains. Kast is of the opinion that in many instances there is hypersensitiveness to touch impressions as well as to pain and thermal sensations. There is generated, however, in the segment a hypersensitiveness so that impulses which under ordinary circumstances are not painful are interpreted as such. This condition Kast calls a local neurasthenia. He points out, too, the importance of a general instability of the nervous centres in the development of the hyperesthetic areas. They are certainly better defined in neurasthenic patients. In a normal individual the continuous discharge of centripetal impulses from the internal organs run to the centres, but whatever changes they produce their effects remain in the subconscious sphere. Under conditions of increased sensitiveness to external and internal stimuli (neurasthenia) these impulses enter the conscious sphere and are frequently transformed into painful sensations. Lenander has shown that one may handle or insult in various ways the abdominal viscera without producing pain sensation; that pain sensation can be evolved only from the parietal peritoneum. His explanation of the hyperalgesic skin areas is the interstitial inflammation about and through the spinal nerves caused by a lymphangitis spreading from the diseased organ. Kast takes exception to such a view, urging that the skin zones do not follow the distribution of spinal nerves and that, if such a perineuritis existed, it would give rise to severe neuralgic pains. He believes, too, that under diseased conditions pain sensations do arise in the internal organs. As interesting as the discovery of Head's zones are, they have not proved of great practical value. In the first place, their occurrence is not constant. They are frequently present in gastric ulcer, particularly in anemic nervous patients and in instances with much pain. But in some of the most evident cases they are absent. The same is true of appendicitis and cholecystitis. In twelve cases of gastric carcinoma, all associated with a great deal of pain, Head's zones were present in only one. On the other hand, the zones occur in such a variety of conditions that no conclusion can be drawn, from their presence, of the nature of the disease. The localization, too, Kast finds practically unreliable. Different diseases in different areas may give the same zones. Still, it must be allowed that they frequently lend a valuable clue when a symptom is present, which may have, as a cause, one of a number of widely different sources, for instance, protracted vomiting, which may be

cerebral in origin or come from a gastric ulcer or an appendicitis, etc., or attacks of indefinitely localized pain, which may arise from the heart, intestines, gastric ulcer, cholelithiasis, nephrolithiasis, etc. It is important in our investigations to exclude hyperalgesic areas arising from hysteria or from neuritis or cerebral or spinal lesions and the sensory disturbances which frequently occur with or after infectious diseases and in uremia. These usually have a different distribution. The difficulties in the way of uniform and reliable deductions being drawn from the mapping out of Head's zones are so great as to render the procedure of small practical value with our present means of investigation.

Myeloid Transformation.—HIRSCHFELD (*Berl. klin. Woch.*, 1906, xliii, 1064). Ehrlich, in his classical studies on the blood, drew a sharp line of distinction between the generation of the granular leukocytes and the lymphocytes, the former always arising in the bone-marrow, the latter always in the lymph glands and spleen. Extending these views to disease he drew the same distinguishing line between myelocytic and lymphocytic leukemia, the one type arising in the bone-marrow, the other in the glands and spleen. In the past few years, Hirschfeld, Kurpjuweit and others in man, and Dominici experimentally in animals, have demonstrated, in numerous instances of anemia and infectious diseases, the occurrence of myelocytes, neutrophiles, and nucleated red cells in the spleen and glands and occasionally in the liver. Kurpjuweit and Sternberg claim that myelocytes are regularly present in the spleen in small numbers. Hirschfeld cannot agree with this view, and he has, at his command, an extensive experience. The presence of granular cells he considers a true metaplasia, deriving them from preexisting lymphoid cells or the closely allied large mononuclear cells normally present in the spleen. Similarly certain myeloid tumors in the liver he believes to be autochthonous. In one instance he reports, where they were present in large number, he can see no other explanation of their occurrence, as there were at no time myelocytes in the circulating blood. In three cases of lymphatic leukemia, which he has recently observed and briefly reports in this article, he likewise found extensive myeloid transformation in the spleen and glands. The bone-marrow in three cases contained very few granular cells, while myelocytes and nucleated red cells were abundantly present in the myeloid areas of the spleen and lymph glands. The view that such areas may have been bone-marrow metastases he thinks is refuted by the fact that in two of the cases large numbers of myelocytes were never present in the blood, and in a third the myeloid transformation of the glands was extreme, while only slight in the spleen. It would be difficult to understand why metastases should have shown such a selective action for the glands. In the present state of our knowledge of blood histology, there can be no longer any objection to accepting mixed forms of leukemia. Cases of myeloid leukemia have been reported changing into a lymphoid type. Such evidence as Hirschfeld furnishes leaves no doubt of the occurrence of mixed types of the disease. In myeloid leukemia the spleen and gland tumors do not consist solely of myeloid tissue, but the lymphocytes have a large share in their structure. In the two forms of the disease one type predominates, but not at the expense of the other, which, likewise, hypertrophies. The sharp barriers established by

Ehrlich between the granular cells and the lymphocytes and between myeloid and lymphoid leukemia have been broken down. This does not mean that all distinction is lost and that myeloid and lymphoid leukemia become identical. They probably represent two different diseases which must be histologically and etiologically separated. But a large number of transition forms do occur.

SURGERY.

UNDER THE CHARGE OF

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An Experimental Study of Suture of Arteries, with a Description of a New Suture.—DORRANCE (*Annals of Surgery*, 1906, xliv, 409) reviews the methods in use, with their advantages and disadvantages. He then describes his method and gives in detail his experiments on nine horses and five dogs. The method consisted in approximating intima to intima with a continuous through-and-through mattress suture modified by going back one-half a stitch every third suture, in order to overcome purse-stringing; over this he placed a continuous overhand suture. Special stress is laid on the following points: (1) Whatever suture is used the principle of placing intima to intima is absolutely essential, and (2) the suture and fringes of the intima should not be exposed to the blood stream.

Suprahyoid Pharyngotomy.—v. HACKER (*Zentralbl. f. Chir.*, Nov. 10, 1906) says that the technique of oblique or transverse pharyngotomy has been developed from observations made upon suicidal wounds occurring in this region, which, in general, lie chiefly below the hyoid bone. The view obtained of the entrance into the larynx and pharynx, through a suicidal wound, and the healing which followed, led to the development of subhyoid pharyngotomy as an operation. A similar suicidal wound above the hyoid bone suggested the performance of suprahyoid pharyngotomy. Hocher has recently, again, recommended very highly the subhyoid operation. He avoids tracheotomy when possible, performing it secondarily only when a laryngeal nerve has been wounded. When tracheotomy is not done he places the body in an oblique position. He does the operation under local anesthesia with applications of cocaine solution to the mucous membrane. v. Hacker found this method very satisfactory in two cases in which he did thyrotomy, or splitting of the thyroid cartilage, for the removal of cancers of the larynx.

It was Jeremitsch, of Moscow, who, in 1895, first recommended suprahyoid pharyngotomy in place of the subhyoid operation, in consequence of observations made in the treatment of a suicidal wound above the hyoid bone. The gaping wound gave a very free exposure of the entrance to the larynx, and of the posterior and upper part of the pharynx, and was closed with a primary suture.

The special advantages claimed for this operation are: the greater room and freer access afforded, especially when an operation is to be done on the root of the tongue or the whole of the tongue is to be extirpated; and above all it avoids the danger of wounding the laryngeal nerve, while the epiglottis is not in the least danger. v. Hacker confirmed these statements of Jeremitsch on the cadaver, and this led him to try the operation in the living when a suitable case presented itself. This was a round-cell sarcoma of the base of the tongue, in a man aged sixty-three years, who was very much emaciated and weakened. Because the patient desired narcosis it was given and was administered through a high tracheotomy wound, with the body in an oblique position and the head depressed. The incision was carried on each side to the edge of the sternomastoid. The lymph glands were easily removed, and the lingual artery ligated on each side beyond the cornu of the hyoid bone. After division of the muscles (mylohyoid, geniohyoid, and hyoglossus) access to the base of the tongue and, finally, to the posterior and upper part of the pharynx was very free. The rather large tumor, with a part of the epiglottis which was in the grasp of the tumor, was easily removed with the thermocautery. The remaining parts of the tongue were brought together throughout, the divided muscles were united, drainage was placed in the lateral angles of the wound, and the cannula removed. The healing of the wound was normal. Symptoms of heart weakness set in, however, and on the tenth day the patient died. He had been nourished through a tube in the nose. The autopsy showed degeneration of the heart, hypostatic pneumonia, and marasmus. The wound healed by first intention.

The suggestion is made that because of the free access to the posterior and upper part of the pharynx this operation should be done as a preliminary step in the removal of nasopharyngeal tumors. v. Hacker believes that it will prove to be a very advantageous operation.

Rupture of both Kidneys, with Intraperitoneal Hemorrhage; Removal of all of the Left Kidney and Part of the Right Kidney.—FRANKLIN (*Amer. Jour. Surg.*, 1906, xx, 309) reports the following very interesting case: A girl, aged sixteen years, fell a height of four feet from a car, landing on her abdomen across a rail. She felt that she "had torn something loose on the inside," and, although she had some pain, she walked home, a distance of about a quarter of a mile. When seen by Franklin, about an hour later, she had a temperature of 98° and a pulse of 127, with other symptoms indicating severe shock. She vomited a greenish material several times. The abdomen was distended, the right rectus rigid, the right kidney region tender, with dulness on the right side, especially in the right iliac fossa (the patient was lying on her right side). By catheter two ounces of very bloody urine was withdrawn. Intraperitoneal rupture of the right kidney was diagnosed. Owing to objections on the part of the patient and her parents the operation was

not begun until about eighteen hours after the accident. She stood the operation well for the first hour, but later did poorly because of the great loss of blood. A large quantity of blood and urine was found in the peritoneal cavity, which was cleaned out and flushed with normal salt solution. The right kidney was found low in the abdomen, lying directly in front and over the third and fourth lumbar vertebræ. It showed three transverse rents and was tied at its lower pole to the left kidney by a dense fibrous band a half-inch in diameter (horseshoe kidney?). The left kidney was literally torn into fragments, entirely without a capsule, and separated from the ureter. The vessels of the left kidney were ligated and all the pieces removed. A portion of the right kidney, which had been mashed into a pulp, was removed also. The remaining portion of the right kidney (not more than two-fifths of the original kidney substance) was in a very bad condition and showed two rents. It was packed with gauze. The abdomen was filled with normal saline solution after repeated flushings, then closed with through-and-through sutures of silkworm-gut, and drained. After-treatment for the shock was carried out. From the time the reaction set in, ten hours after the operation, the patient did well. The gauze was removed on the sixth day. A urinary sinus followed, through which most of the urine passed for the next five days. It closed on the sixteenth day. The patient sat up on the thirteenth day and left the hospital on the twenty-third day. She has enjoyed good health ever since (now more than six months) and passes a normal amount of urine.

Treatment of Tuberculous Abscesses.—STARR (*Brit. Med. Jour.*, 1906, ii, 923) says that abscesses following tuberculous bone disease, so long as they remain quiescent as closed sacs and do not become infected, add no danger element to the local or general condition. It is well known that a proportion of abscesses if properly treated disappear in the patient suffering with bone lesion. If the abscess is allowed to open spontaneously it will become infected very quickly with septic organisms. On the other hand, if it burrow too close to the skin, one of two things may happen: it may become infected with the organisms from the hair follicles or sweat glands, or the skin may become invaded with the tuberculous disease. As to treatment, aspiration has several advantages, but generally is not advisable. The injection of germicidal agents does not seem reasonable, as any agent which can be safely injected into a closed sac without endangering life can scarcely be expected to have any beneficial effect. Excision of the sac entire cannot be carried out in any of the abscesses from spinal disease, but is a perfect method for very small abscesses that are free of the joints in accessible parts of the extremities. Incision and drainage always result in a long-continued discharging sinus, often endangering the life of the patient and always making his condition annoying. Incision, evacuation of the contents, curetting of the wall, and closing of the wound constitute the treatment of choice. Of fifty-five cases so treated by Starr, seven afterward broke down, while the remaining forty-eight, so far as can be traced, have remained perfectly closed and aseptic for periods varying from four months to six years. Only five of the series required a second evacuation of contents, and one a third.

The Treatment of Wounds after Transplantation.—WEISCHER (*Zentralbl. f. Chir.*, June 23, 1906) objects to the open-wound treatment after Thiersch's skin grafting, because the discharge coagulates at the edges of the grafts and being retained underneath separates it. Nor does he believe with Isnardi that it is necessary to wait six weeks for the development of a proper granulating surface, in large traumatic defects of the skin surface. Only too frequently the back and posterior surfaces of the extremities are involved where it is difficult to relieve the pressure, and, therefore, to obtain a clean granulating surface. The wounds are frequently impregnated with dirt and oil. In relatively small wounds when the discharge is slight and serous, little difficulty in healing arises, whether the open method or the boric ointment and compression treatment are employed. When the secretion is abundant and purulent, very rarely can one obtain a wound that is entirely free from pus. The abundant streaks of pus which are usually present can be washed away with saline solution. The upper layers of the granulation tissue are then evenly removed with a proper knife, giving a smooth surface upon which to spread out the grafts. On a limb the part should be bloodless during the grafting, and when the Esmarch bandage is removed the hemorrhage should be controlled by the application of layers of lint moist with warm salt solution. Because the heat quickly disappears, warm water should be poured on almost continuously for about fifteen minutes or a half hour. Then the wound and grafts are covered with a layer of lint and that with cotton, both moist with the warm salt solution, and a bandage applied. When in bed the patient should have a wide mackintosh under the part and a wire frame over it to prevent contact of the bed-clothes with the dressings, and to favor evaporation of the discharge. Every two or three hours for two days, fresh, warm salt solution should be dropped on the dressing, until it is felt by the skin. This dressing favors the escape of the discharge from under each graft, prevents coagulation at the edges, retention under the grafts, and their separation from the granulating surface. The dressing is first renewed in forty-eight hours, after thoroughly soaking it. After two more days a boric ointment dressing is substituted. Weischel obtained a 100 per cent. of "takes" in three-quarters of the cases, 80 to 90 per cent. of "takes" in one-quarter, and did not completely fail in any.

High Hemorrhoids as a Cause of Occult Blood in the Stool.—GOLDMANN (*Zentralbl. f. Chir.*, June 30, 1906) says that from methodical examination of the rectum with a protoscope during recent years, he has several times found highly situated hemorrhoids to be the cause of obscure hemorrhages from the bowel. In one case about 10 cm. above the anus he found on the anterior surface of the rectum, small dilated prominent veins. From some, blood was oozing, while others were covered with clotted blood. The remaining mucous membrane in this region was the seat of a slight catarrh, but was otherwise normal. With a specially devised galvanocautery the veins were destroyed, through a proctoscope. A complete and permanent cure followed. Schreiber has localized solitary and multiple varices, 15, 16, and 19 cm. above the anus. He found venous anomalous conditions in not less than 10 per cent. of the cases he examined. The treatment of such hemorrhoids can only be operative, and they can be easily and permanently removed by the galvanocautery.

Appendicitis in Nursing Children.—KIRMISSON and GUIMBELOTT (*Revue de Chir.*, 1906, xxvi, 441) collected 26 cases under two years of age, 9 occurring in the first year and 17 in the second. Of the 26, 19 died and 7 were cured. Of the 9 cases occurring in the first year, all died. The 7 cases cured were all under eighteen months of age. Operation was performed in 19 cases, 7 in the first year and 12 in the second; 7 were cured and 5 died. From these facts Kirmisson and Guimbelott draw the following conclusions: Appendicitis in the first two years of life is not as rare as has been thought. Its evolution is rapid and its prognosis extremely grave. The only cases cured up to the present were those in which operation during the attack was performed; therefore, the indication to operate immediately seems clear. The greatest difficulty in reaching a decision to operate is the difficulty in making a diagnosis. Kirmisson and Guimbelott consider that it is, therefore, desirable that all cases of this kind be published.

Hemorrhage of the Scalp in Operations on the Skull.—KREDEL (*Zentralbl. f. Chir.*, 1906, xxxiii, 1137) controls the always unpleasant and sometimes dangerous hemorrhage of the scalp in brain operations by a method which he considers simple and rapid. Before the incision is made, he applies two narrow metal plates to the scalp, by a ligature passed under the scalp along the bone, the plate and ligature on each side of the incision being parallel to the incision, and about 1.5 cm. from it. The plates may be from 5 to 7 cm. long, or shorter, and in case the longer are to be employed, it will be best to bring the needle out about the middle of the plate and to reintroduce for the rest of the distance covered by the plate. The two ends of the ligature are then caught in a notch at each end of the plate, and are tied and knotted over it, thus compressing the tissues of the included portion of the scalp between the ligature and the plate. According to the length of the incision, one or more plates may be used on each side of the incision. The plates are 1 cm. wide, 0.5 cm. thick, of variable length, and slightly curved to fit the vault of the skull. It may also be curved or straight to adapt itself to the shape of the scalp incision. These curves, however, should not be too marked, because the tightly drawn ligature tends to form a straight line between the two ends of the curved plate, so that the included scalp is not compressed properly. This can be prevented by passing a second smaller ligature around the plate and first ligature at their middle, to prevent them from sliding away from each other.

Bier's Treatment in Tuberculosis and Acute Infections.—AUFFRET (*Revue d'Orthopédie*, 1906, vii, 481) says that Bier applies his treatment to very diverse conditions, infectious and non-infectious, acute and chronic; but he embraces under it three different modes of treatment, all having the same object, congestion of the affected part. He thus includes hot baking, compression by the elastic bandage, and aspiration with cupping glasses or a special apparatus. Hot baking and the aspiration method are recommended in the non-infectious conditions; the former in chronic rheumatism, arthritis deformans, old arthrites, and chronic œdemas; the latter when one wishes to exercise a more energetic action (old traumatic lesions, etc.). The cupping apparatus of Klapp should be employed in the localized infections when pus

has already formed, particularly in mammary abscesses and buboes, furuncles, lymphatic glandular abscesses, and superficial panaris. The anodyne effect of the elastic bandage upon the pain makes it the treatment of choice in gonorrhœal arthritis, because it soon permits immobilization. The anesthetic and bactericidal properties are of advantage in painful affections, as acute arthritis, early metastatic foci, and infected wounds. In the presence of grave suppuration (osteomyelitis, suppurative arthritis, deep phlegmons, panaris, etc.) the first indication is to make a free incision for the escape of the pus; but the venous stasis renders service of secondary importance. It aids in the formation of an œdema of which the bactericidal properties seem proved. It facilitates the escape of pus and permits in many cases the early stoppage of packing and drainage.

An Ideal Retention Bandage for Inguinal Hernia in the Infant.—FIEDLER (*Zentralbl. f. Chir.*, 1906, xxxiii, 1161) says that the non-operative treatment of this condition sometimes offers difficulties. Those methods in present use frequently fail, because they do not remain firm on these restless patients. The unavoidable soiling of the apparatus leads to eruptions of the skin, infection of the lymph glands, and pain from pressure of the apparatus. Fiedler improvises a supporting apparatus from a layer of white woollen yarn, of about twenty to thirty strands. He makes of these a loop about 35 to 45 cm. long, according to the size of the patient. The ends of these are fastened together by two pieces of white, slender, linen bands. The hernia is first reduced, the loop is passed around the body, and the ends, tied together by the linen bands, are passed through the loop. The point of crossing through the loop is made to lie over the hernial orifice, and the ends are drawn tightly around the thigh and fastened by the linen bands to the girdle about the abdomen. The hernia can be kept in place by the elastic pressure, while the apparatus is so cheap and easily made that it can be frequently changed and kept clean.

A Contribution to the Operative Technique of Orchidopexia.—DE BEULE (*Jour. de Chir., et Annal. de Soc. Belge de Chir.*, 1906, No. 8, p. 390) describes his method of operation as follows: After drawing down the testicle, he incises the skin of the fundus of the scrotum anteroposteriorly for about 3 cm. and brings the testicle out of the incision. A second incision of the same length in the axis of the limb is made in the thigh below the genitocrural crease, well within the femoral vessels and down to the deep fascia. The testicle is then sutured into the bottom of the thigh incision to the deep fascia, the outer edge of the scrotal incision having first been sutured to the corresponding edge of the thigh incision. The remaining corresponding edges of the scrotal and thigh incisions are then sutured together and the entire wound thus closed. The sutures holding the testicle to the deep fascia of the thigh pass through the tunicæ vaginalis and albuginea. A gauze and collodion dressing is laid over the circular line of sutures, which hermetically seals it. If the patient is a child, he is watched carefully for a few days, and his knees are tied together to prevent abduction of the thigh, and, therefore, tension on the wound. The sutures are removed in ten to twelve days, when the patient may get up and walk.

Later, the connection between the scrotum and thigh is divided, the testicle being carefully separated and the wounds in the scrotum and thigh closed. De Beule has obtained excellent results in two cases, which were far from being favorable.

THERAPEUTICS.

UNDER THE CHARGE OF

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The Serum Treatment of Exophthalmic Goitre.—G. A. WATERMAN (*Boston Med. and Surg. Journ.*, 1906, No. 7, p. 165) reports five instances of Graves' disease treated by means of hypodermic injections of serum derived from blood drawn from the jugular vein of a goat, two weeks or more after the removal of the thyroid gland. Two of the patients are considered as cured, two improved, and one unimproved. Waterman considers this number insufficient for estimating the value of the treatment, but, looking over all the instances in which serum-therapy has been employed, he feels that in this method we have a means which influences the disease favorably, and which may, with further modification, prove of more uniform value. In his opinion, it may be along this line or by the use of cytotoxic serum, which has been so successfully used by BEEBE and ROGERS (AMER. JOUR. MED. SCI., vol. cxxxii, No. 1, p. 149) that we are to find a specific means of relieving the distressing symptoms of this most troublesome disease. The doses of the serum employed were from 15 to 45 mm., given at first daily, the intervals being increased as benefit was obtained. Continuation of the treatment for months is necessary.

Serum in Exophthalmic Goitre.—S. P. BEEBE (*Jour. Amer. Med. Assoc.*, 1906, xlvii, 66) concludes a paper upon this subject as follows: "When all the conditions are considered, I believe it is fair to conclude that the serum is an agent of considerable value in the medical treatment of exophthalmic goitre. It has been used in all manner of cases in which it was possible to make a diagnosis, and in some cases in which the diagnosis was doubtful. Only a comparatively small percentage of trials has resulted in failure, a much larger number in improvement, while an encouraging number of individuals have been completely cured. In making up statistics, all the cases of which we have any record have been included. A number of the patients have begun

treatment so recently that it is not possible to make any safe conclusion of the outcome. The number of instances of cure and improvement is so large that it cannot be ascribed to coincidence, and, under favorable conditions, I believe much can be accomplished by serum-therapy."

Prophylactic Antisepsis.—CREDE (*Münch. med. Woch.*, 1906, No. 24, p. 1160) states that the strictest asepsis in the management of accidental and operative wounds may fail to prevent primary or secondary infection and advises prophylactic antisepsis in the form of collargol. This agent is non-irritant and effective and is taken up by the tissue fluids and circulates through the body, without local caustic effect. In instances of fractures complicated with infected wounds sequels such as necrosis, lymphangitis, septic and phlegmonous processes may occur, no matter how thorough the cleaning of the parts has been. Here collargol assures quick healing without reaction. Tissues that seem to have lost their viability often regain vitality in a surprising fashion and recovery is usually rapid. Credé considers that every injury should be treated with this agent and that it is equally advantageous after operations, no matter how carefully conducted these may have been. Collargol may be employed as a 3 per cent. dusting powder mixed with finely pulverized lactose or one and a half ounces of a 1 per cent. solution may be used as an irrigation for wounds, cavities, the bladder, etc. Tablets of collargol may be inserted into bullet wounds, into the wound of a compound fracture, or may be placed upon contused brain tissue. Collargol may also be used for syringing, as a gargle, an eye wash, internally in wounds of the stomach, and in the form of bougies or suppositories. Argyria is said to never follow its employment.

The Serum Treatment of Experimental Cerebrospinal Meningitis.—SIMON FLEXNER (*Jour. Amer. Med. Assoc.*, 1906, No. 8, p. 560) describes certain experiments which he has made in the production of cerebrospinal meningitis in animals, and in the serum treatment of the same. He considers that the experiments may have some value in helping to understand the characteristics and effects of the Diplococcus intracellularis. The experiments concerning the prophylactic and therapeutic properties of antisera prepared from the diplococcus are sufficiently encouraging to warrant further study. How far the results obtained on guinea-pigs and monkeys can be applied in man, it is not safe to predict. Should further experimentation show that injections of antisera can favorably modify the experimental disease in monkeys, the case would not be without hope. Flexner does not think that the injection into the spinal canal of man of alien sera should be undertaken until their physiological action has been worked out in more detail in monkeys. If it were practicable to employ monkeys for producing the antisera to be used in man, the danger of serum intoxication might be lessened while the good effects of the immunity principles were retained.

Tetanus Antitoxin.—W. D'ESTE EMERY (*The Practitioner*, 1906, lxxvii, 478), in a paper upon serum-therapy, states that tetanus antitoxin is of little value in acute tetanus, but in chronic tetanus it is

of great benefit in affording relief to the symptoms and in distinctly improving the chances of recovery. It frequently happens that the improvement which follows each injection is so marked and so greatly appreciated by the patient that it carries distinct conviction to the medical man. The dosage of the agent is simple; large doses are required and they should be repeated whenever their effect becomes apparently lessened, or, if there is no obvious effect, within a few hours. The best site of administration is not so well established. There are six possibilities: (1) Subcutaneous; (2) intravenous; (3) intracerebral; (4) intraspinal injection; (5) application to the nerve leading to the wound, and (6) local application. In chronic instances, subcutaneous injection will be adequate, though the advisability of intravenous injection may be considered. In very severe instances of acute tetanus, the intracerebral injection has given striking results; about 150 minims is injected into the lateral ventricle after drilling a hole or after trephining. Intraspinal injection is probably not more advantageous than hypodermic administration. Local application to the wound should not be relied upon, but may be employed in connection with subcutaneous injection.

Sodium Salicylate in Scarlatinal Arthritis.—Ralph Stockman (*Edin. Med. Jour.*, 1906, xx, 244) has followed a number of instances of scarlatinal arthritis and reports his observations as follows: In five of the patients no treatment was adopted and the symptoms subsided in two, three, four, seven, and eight days. To eleven patients, sodium salicylate was given in ordinary doses, and in these the joint symptoms subsided in one, one, two, three, five, six, seven, eleven, twelve, thirteen, and seventeen days. Thus, it would seem that the untreated patients ran the more favorable course. In most of the cases the arthritis was slight, recovery was apparently spontaneous, and it seemed immaterial whether the salicylate was given or not. This is in accord with clinical experience. In scarlatina, as in other microbic infections, the joint involvement is to be regarded as a part of the general poisoning; and, as sodium salicylate does not benefit the primary disease, it also leaves untouched the joint affection. While this is true in most instances, in others, as in the cases in which the joint implication disappeared in a day or two after the administration of the salicylate, it seems clear that we have to deal with a true rheumatic arthritis complicating the scarlatina. Stockman considers that only in rheumatic fever have the salicylates a specific action, and the joints are especially benefited because the remedy is secreted into them from the blood. He believes that the salicylates are as truly specific in acute rheumatism as is quinine in malaria, or mercury in syphilis.

The Action of Aspirin upon the Uterus.—F. Chidichimo (*Therapeut. Monatsschr.*, 1906, No. 8, 389) quotes the following statements of Dilluberger, which are the conclusions of the latter drawn from his clinical observations: (1) Aspirin acts well in ovarian dysmenorrhœa, since it not only diminishes the general nervousness but also lessens the ovarian hyperesthesia. (2) In uterine dysmenorrhœa, with functional nervous disorders which have no organic basis, it acts as a strong analgesic. (3) In severe diseases of the adnexa and chronic metritis.

the drug lessens the intensity of the dysmenorrhœa. (4) If one administers aspirin shortly before menstruation the dysmenorrhœa will be suppressed. (5) Aspirin has a beneficial influence upon amenorrhœa and menorrhagia. Chidichimo, himself, finds that aspirin slows uterine contractions and exercises an analgesic effect. It is not excreted in the milk of nursing women. It causes diminution of pain in the genital apparatus, whatever its cause may be. The usual dosage is 10 to 15 grains, two or three times daily. The drug is said to have no disturbing effect upon the stomach or kidneys nor does it cause headache or tinnitus.

The Specific Treatment of Tuberculosis.—H. HOCHHEIM (*Zentralbl. f. die Gesamte Therapie*, 1906, No. 8, p. 393) concludes a paper upon this subject with the following *resume:* In the treatment of phthisis we have no certain therapeutic agent; the treatment of the disease is tedious and requires much patience both in physician and patient. One of the most approved means of treatment is the administration of thiocol (potassium sulphoguaiacolate), which may be given in powder, capsules, or solution, in daily dosage of about 30 grains. The drug is tasteless and has no disturbing effect upon the stomach. Its particular disadvantage is its costliness.

The X-rays and Resorcinol in Lupus.—S. EHRMANN (*Sem. med.*, 1906, No. 37, p. 439) reports excellent results from the combination of these two agents. His technique is as follows: First, a dressing impregnated with a 33 per cent. resorcinol ointment is applied; this is removed after about twelve hours and the lesion is curetted with a sharp spoon, or a tampon wet with mercuric bichloride solution is applied. The procedure is repeated after four or five days, and *x*-ray treatment is begun. The resorcinol applications are continued at intervals. Later, dressings of boric-acid ointment are applied, and, after a time, the treatment above described is again instituted. The cycle is continued until cure is completed, which is usually accomplished in from two to seven months.

PEDIATRICS.

UNDER THE CHARGE OF

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The Influence of Vaccination upon the Evolution of Infectious Diseases.—L. JESIERSKI (*Jahr. f. Kinderheilk.*, 1906, xiv, 337) details some interesting observations upon this point, made possible by the occurrence of smallpox in a hospital ward containing scarlatina patients. A child aged eight years, suffering from scarlet fever, presented a smallpox eruption ten days after admission to the ward. In consequence, all

of the children in the service were at once vaccinated; these embraced 22 scarlatinous, 10 tuberculous, 1 leprous, and 5 typhoid patients. Of the 22 scarlatinous, 11 were more or less severely disturbed by the engrafted vaccinia: with some the evolution of the scarlatina was prolonged, while with the others various complications were noted. None of these children had been previously vaccinated. In the remaining 11 patients, 6 of whom had been previously vaccinated, vaccinia seemed to produce no disturbance. Of the 10 tuberculous patients, 1 alone presented any abnormal phenomena. Among the 5 typhoids, all of whom were convalescing, 4 presented no unusual disturbance; in the fifth, however, there was a marked infiltration of the arm with a temperature rise to 102.6°, which became normal on the fifth day. In the leprous patient, a boy aged seven years, vaccination produced no complication. It is interesting to note that in the contents of the vaccinal pustule lepra bacilli were present.

Congenital Rachitis.—MARFAN (*Semaine med.*, 1906, No. 41, p. 481) concludes a study of congenital rachitis with the following propositions:

1. There is a congenital rachitis latent at birth, or only to be detected by microscopic examination. In these cases the bony deformities are not appreciable until some time after birth. Whether this form can be distinguished from an early acquired rachitis by any definite sign is not known; but when a rachitis begins very early with craniotabes, and when the softening of the cranial bones is clearly appreciable before the fifth or sixth week, it seems probable that the disease began before birth.

2. A certain number of infants affected with congenital rachitis are born dead or non-viable. It is among these that cases of excessive osseous deformity are found; these are observed by the accoucheur during parturition and are often accompanied by visceral malformations. As pointed out by Porak and Durante, we now know that even in these cases of excessive deformity the clinical diagnosis is not always possible; that micromelia is not necessarily a distinctive feature of achondroplasia, but may exist also in periosteal dysplasia and in rachitis, though inconstant in the former and rare in the latter; and that it is sometimes necessary to employ the microscope and x-rays in order to distinguish these osseous dystrophies.

Two forms which especially interest the physician are those in which congenital rachitis, evident at birth, is compatible with life and continues to develop after birth, and in which the evolution demonstrates the nature of the osseous alterations observed at birth. Typical examples of these forms are furnished by the cases reported by Marfan.

3. In the one representing the rarest condition the skeletal deformities are from birth so extended and so characteristic that, though slight, one cannot mistake their nature: enlarged cranium, with prominent forehead and jutting bosses, enlarged fontanelles, and often separated sutures, distinctly enlarged costal nodosities, enlarged epiphyses, and curved diaphyses. If the child is carefully guarded and escapes serious infections the deformities show little increase, becoming slightly accentuated after birth, then remaining quiescent for a long time, and finally disappearing toward the end of the second year.

4. In the second form of the disease there is at birth craniotabes, either alone or associated with a slight costal rosary. Differing from the preceding form, the rachitis here progresses after birth, as if, at the time of parturition, it was in its first stage; later on one sees characteristic deformities of the cranium, thorax, and limbs develop. At the same time, as in the preceding case, if the child is well cared for and escapes serious infections, the rachitis remains quite slight in degree and disappears without leaving decided deformity. As common characteristics of these two forms, Marfan states that such children are born most frequently before term, are below normal weight at birth, and present, in the course of the first two years of life, an anemia more or less profound.

Perforating Scarlatinal Angina.—GUINDESSE (*Semaine med.*, 1906, p. 138) has observed three cases of primary perforating angina in the course of scarlet fever, which presented some analogies with the perforations of the uvula lately described by Méry and Hallé.

In the first case, a girl aged fifteen months, admitted to the hospital on the fifth day of a grave scarlatina, there were already at the time of admission two perforations symmetrically situated in the anterior pillars, having the form of longitudinal slits about 0.5 cm. in length, with smooth edges of deeper color than the surrounding tissues. The child died, after eight days, of septicemia.

The second case was that of a boy aged five years, admitted to the hospital on the third day of a particularly benign attack of scarlatina. As the result of a necrotic process affecting the uvula and developing after admission, a complete perforation occurred about the end of the second week. There was little tendency to healing and the perforation remained, though somewhat diminished in extent, at the end of fifteen days, when the child was removed from the hospital. The third observation concerns a girl of eleven years, with whom the disease was complicated from the beginning with diphtheria, and the perforation observed later in the anterior pillar could perhaps be attributed to the latter disease; but since it persisted at the end of three weeks, when there were no traces of diphtheria remaining, it is likely that here again the perforation was primitive. Contrary to the observation of Méry and Hallé, perforating angina was not accompanied, in Guindesse's cases, either by a general reaction particularly marked, or by phenomena of local inflammatory reaction; the temperature was not greatly elevated, and there was no submaxillary adenopathy.

Guindesse does not consider perforative angina as indicating necessarily a severe prognosis; it may occur with mild infections as well as with the severer forms. Perforation, however, being the consequence of penetration of the streptococcus deep into the tissues, should be considered as one of the manifestations of a general streptococcic infection, and, as such, increases in a certain degree the gravity of the prognosis.

OBSTETRICS.

UNDER THE CHARGE OF

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Mitral Stenosis and Pregnancy.—FRENCH and HICKS (*Jour. Obst. and Gyn. Brit. Empire*, September, 1906) contribute an interesting paper upon this subject, comprising a study of over 300 cases. Of 300 consecutive patients 205 were married. In 66 per cent. no direct relation between pregnancy and heart failure could be proved. The average number of children to each mother was 4.5. In 28 per cent. there was a direct relation between childbearing and heart disease. In 25 the heart trouble began in pregnancy, while in 25 the first symptoms were observed in the puerperal state. In 7, it was impossible to determine whether the heart disease showed itself first, before, during, or after the birth of the child. As regards the result of mitral stenosis complicating childbirth, among those patients in whom the heart disease did not begin in pregnancy, 33 per cent. died in the hospital. Of those in whom heart disease began during pregnancy, 35 per cent. died in the hospital. Among 13 patients having mitral stenosis, who married but never became pregnant, 46 per cent. died in the hospital. While it is difficult to draw conclusions from hospital statistics, the mortality among married women having children and suffering from mitral stenosis, does not seem to be different from that of unmarried women, with the same heart lesion. In endeavoring to form a prognosis concerning the recovery or death of a pregnant patient suffering from mitral stenosis, great difficulty is experienced. After reviewing a considerable number of cases, the authors find that many patients suffering from mitral stenonis, and pregnant, did not develop symptoms during pregnancy sufficiently severe to send them to the hospital. The majority of these patients showed the same symptoms which non-pregnant patients with mitral stenosis presented. The treatment of mitral stenosis during pregnancy consisted in rest in bed and the administration of digitalis. Induction of labor was rarely necessary, and there was little postpartum hemorrhage. If the patient is able to be up and about without cardiac distress, it is best for her to do so. If cardiac failure threatens, she must remain absolutely quiet. There was no evidence in this series of cases that mitral stenosis tended to sterility. Among the complications most severe and fatal was fungating endocarditis. This was present in 23 per cent. of cases in which failure was not attributed to pregnancy. In 41 per cent. of those patients in whom heart disease began during pregnancy, this complication was present. In 39 per cent. of single patients, endocarditis was also found. It was not, however, present in any patient who, although married, had not been pregnant. In the whole series of fatal cases, endocarditis was found in 29 per cent.

The writers conclude that pregnancy may cause serious and even fatal heart failure in cases of mitral stenosis. They believe, however, that the dangers of pregnancy in these cases have been considerably overestimated, because based upon statistics taken from patients who

did not report for treatment until heart failure had developed. They also conclude that comparatively few of these patients are sterile, and that among them abortion is not especially frequent. Labor is usually successful. Heart failure develops most often after successive pregnancies. The treatment of the condition is the same as in the non-pregnant. It is not always right to deny marriage to women who have mitral stenosis. The general condition of the patient, and her circumstances in life, should be taken into consideration.

Abdominal Hysterectomy for Inversion of the Uterus.—BARBOUR (*Jour. Obs. and Gyn. Brit. Empire*, October, 1906) reports an interesting case of inversion of the uterus, complicated by fatty degeneration. The patient was a multipara, delivered at full term two months before admission to the hospital. Labor was difficult and terminated by the use of forceps. There was considerable hemorrhage. After the delivery of the child the patient could not empty the bladder, and after getting up, was examined by a physician, who informed her that inversion had occurred. There was no hemorrhage. On admission to the hospital the pelvis was contracted. The uterus was completely inverted. Under pressure, partial replacement occurred, but could not be successfully completed. Complete inversion recurred when pressure ceased. A week later the abdomen was opened and the patient placed in the Trendelenberg position. A cup-shaped depression was visible in the floor of the pelvis, crossed by a transverse slit, into which the Fallopian tubes were drawn The posterior rim of the cup was incised. Pressure was then made on the inverted fundus through the vagina, and the uterus was replaced. It was found to be the seat of marked fatty degeneration and was accordingly removed. Supravaginal hysterectomy was done, and one ovary was removed with the uterus. The patient was discharged three weeks after operation. Microscopic examination of the uterine wall showed fatty degeneration of the muscle fibers, and between them extravasation of blood. This process affected especially the outer third of the muscular wall.

Spontaneous Inversion of the Uterus: Vaginal Hysterectomy.—FERGUSON (*Jour. Obs. and Gyn. Brit. Empire*, October, 1906) reports the case of a primipara who had a slow and tedious labor. The occiput was posterior, and the child was easily delivered with forceps without rotation of the head. The placenta was delivered by suprapubic pressure, the uterus contracting and retracting satisfactorily. There was no abnormal hemorrhage, the patient making apparently a good recovery. She did not nurse the child. At the end of the third week she resumed her usual duties, feeling perfectly well. Three weeks after this she had a considerable red, vaginal discharge. At the end of six weeks this suddenly increased, and was supposed to be menstrual. The bleeding increased, and she consulted a physician, who found her suffering from inversion of the uterus. An endeavor was made, under ether, to replace the womb, but this failed, the patient having very free bleeding. Two months after confinement she was seen in consultation. Manipulation produced such hemorrhage that the vagina was firmly packed with iodoform gauze to arrest the ble ding, and to try the effect of continuous pressure. The patient's condition was so critical that she was

at once removed to a hospital in considerable shock. As the hemorrhage was not entirely controlled, the patient was anesthetized and thoroughly examined. The inverted uterus was r. d, congested, and bled upon the lightest touch. The orifices of both Fallopian tubes could be seen. Efforts to reinvert the uterus produced persistent bleed ng. An incision was then made into the posterior fornix opening into Douglas' cul-de-sac. The index finger of the left hand was passed into the inverted cup when the constriction ring was found very unyielding. The posterior uterine wall was incised, but even this was not successful. Vaginal hysterectomy was then performed, with clamps. The ovaries were removed with the uterus, and a small subperitoneal fibroid was found near the entrance of the inversion. The patient collapsed after operation, but was resuscitated, and made a good recovery. The case was interesting for the following reasons: The etiology was obscure. A partial inversion probably existed when the placenta was delivered, and this must gradually have gone on to complete inversion. At labor the patient received skilled attention by two experienced obstetricians. The puerperal period was carefully conducted, and under constant observation. The condition developed very gradually, hemorrhage being the only significant symptom. Treatment was exceedingly difficult, because manipulation excited copious bleeding. The uterine wall was so friable that it could readily have been ruptured, and hence, a repositor could not be used.

Fifty Cases of Labor Complicated by Organic Disease of the Heart.—INGRAM and LONGRIDGE (*Jour. Obst. and Gyn. Brit. Empire*, September, 1906) report 50 cases of labor with organic heart disease, from the records of Queen Charlotte's Hospital: In 11,319 patients, these 50 cases were found. Of them 4 (8 per cent.) terminated fatally. In 1 of these, following influenza, the patient had failing compensation with fever. She was delivered by forceps, but died the twenty-eighth day after. Endocarditis, with infarcts in the kidneys and spleen, were present. The second case was admitted in a critical condition, compensation having completely failed. As the child was dead, and forceps failed, it was delivered by craniotomy. The patient died in shock soon after delivery. In the third case the patient, a multipara, had rheumatism and mitral regurgitation. Compensation had failed. Labor was short and easy, but the patient perished ten minutes after delivery. In the fourth case, also of mitral regurgitation, the patient was delivered suddenly while in a cab. She survived labor, but died from dilatation of the heart on the nineteenth day after. Among the primiparæ in this series of cases, five infants were delivered stillborn. Among the multiparæ, five infants died, none of which was viable. In only six of these patients had there been previous miscarriage. In a number of them premature labor came on spontaneously, while in some it was induced. Most of these patients had mitral regurgitation. Twenty of the fifty had stenosis and regurgitation; six had stenosis only; and three had mitral and cardiac disease together. Before labor, compensation was good in 35 of these patients. It was poor in 8, and decidedly bad in 7; only 8 of them had considerable quantities of albumin in the urine; in 27 there was none. Of the total number, delivery took place without assistance in 68 per cent. Among the 50

there were 14 forceps operations. Labor was induced in 6; craniotomy was done in 2; version in one. There were 2 cases of contracted pelvis, 2 of twins, and 2 of adherent placenta. Somewhat more blood than normal was lost in these labors. In 17 cases the condition after delivery was good among the primiparæ; 21 of the multiparæ passed through labor without distress. There were 2 deaths late in the puerperal period, and 6 of the patients suffered from dyspnœa; 3 had symptoms of sapremia. Longridge adds a note upon blood-pressure in pregnancy from the examination of 142 primiparous patients. As pregnancy advanced from the fifth to the eighth month, the blood pressure rose from 120 mm. of mercury to 140 plus.

GYNECOLOGY.

UNDER THE CHARGE OF

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Abdominal versus Vaginal Hysterectomy.—HARTMANN (*Zentralbl. f. Gynäkologie*, 1906, No. 35) thinks that there is no longer any indication for the vaginal operation, even in cases of acute suppuration of the adnexa. He lost only three out of 201 cases of laparotomy for diseased tubes and ovaries, and only one out of seventy-seven hysteromyomectomies. He removes the cancerous uterus by the abdominal route, but does not extirpate the lymph nodes.

Changes in the Adnexa after Extirpation of the Uterus.—BURCKHARD (*Ztschr. f. Geb. u. Gyn.*, 1906, Band lxiii, Heft 1) from experiments with rabbits found that in animals that were killed during the first year after operation the ovaries remained practically normal. Later a progressive atrophy was noted, doubtless due to circulatory disturbances. The tubes were usually unchanged. When a portion of the uterus was left it underwent cystic degeneration in over 50 per cent. of the cases, the wall being much thinned and the cavity containing an albuminous fluid, evidently secreted by the utricular glands.

Resistance of the Germinal Epithelium of the Ovary to Infection.—WOLFHEIM (*Monatsschr. f. Geb. u. Gyn.*, Band xxiv, Heft 1) conducted a series of experiments in animals in order to determine the resisting power of the surface epithelium of the ovary. As mechanical (corpuscular) irritants India ink was used in preference to other staining materials. When introduced into the peritoneal cavity, isolated cells of the germinal epithelium were found to be stained within six hours, but the particles were always arrested in this layer when the ovary was not injured. Hence the inference that the function of this epithelium is to protect the ovarian stroma from injury from without. Cultures of anthrax, streptococci. and staphylococci were employed for bacterial

experimentation, but the results were entirely negative. It was interesting to note that particles of India ink were often found within leukocytes, especially in the lymphatics at the hilum, thus demonstrating the clinical fact that metastasis within the ovary takes place in this way, and not by direct extension from the surface. These results were obtained only when the ovary was perfectly intact; after the slightest traumatism there appeared to be no limit to the extension of the staining.

Decidual Cells in the Non-gravid Uterus.—TAWILDAROW (*Abs. of Thesis in Zentralbl. f. Gyn.*, No. 39, 1906) examined scrapings from 67 uteri, in 56 of which curettement was done for endometritis. He concludes that in simple glandular hyperplasia no cells are of a decidual type are found, but the reverse is true when the glandular and interstitial varieties combined. These cells with increased protoplasmic contents are to be distinguished from true decidual by their flatter nuclei, homogeneous protoplasm, and greater tendency to stain with eosin and picric acid. The changes observed in the endometrium in connection with fibroids and cancer of the cervix are the same as in simple interstitial and glandular hyperplasia, the latter being most common in fibroid uteri. Macroscopically decidual membrane may be mistaken for hyperplasia. Microscopically, the error is impossible, since instead of the dense masses of large cells, rich in protoplasm and containing swollen (blasenförmige) nuclei, and arranged in a compact layer, the hyperplastic endometrium shows only scattered cells of this type. The interglandular tissue of the endometrium is really embryonal tissue, composed of cells surrounded by processes of protoplasm, no fibrous tissue being present under normal conditions. The surface epithelium has no true submucous basis, nor do its glands possess a limiting capsule.

Artificial Distention of the Bladder in Gynecological Operations.—FRANKENSTEIN (*Beit. zur Geb. u. Gyn.*, 1906), Band x, Heft 2, recommends distention of the bladder with boric acid or saline solution previous to opening the abdomen in order to avoid subsequent retention, basing his deduction on 875 laparotomies, in 45.3 per cent. of which he was successful. Ischuria after Alexander's operation was also prevented in 20 per cent. of the cases, but in only 16.9 per cent. of his vaginal sections. This preliminary distention of the bladder is said to allow the operator to enucleate adherent tumors more easily.

Sarcoma of the Vagina in Children.—ROLLIN (*Rev. Gyn. et de Chir. Abdom.*, 1906, tome x, No. 1) adds a case to 11 already reported. Clinically the neoplasm assumes the form of a cluster of grapes (*traubiges sarcom*), preceded by a stage at which it appears as a nodule on the anterior or lateral vaginal wall. The vagina is eventually filled with a reddish-brown mass which protrudes from the vulva, and extends upward to the portio and cervical canal, rarely to the body of the uterus. The neoplasm has a marked tendency to break down and to form metastases, and the bladder is usually involved, cystitis and pyelonephritis being common complications. The rectum is rarely involved.

OTOLOGY.

UNDER THE CHARGE OF
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Some Points in the Diagnosis of the Complications of Temporal-bone Disease Based upon a Study of 135 Fatal Cases.—A. L. WHITEHEAD (*Archives of Otology*, 1906, xxxv, No. 5). During the last fifteen years, 892 cases of temporal-bone disease have been operated upon at the General Infirmary at Leeds, by Whitehead, his colleagues, and his predecessors. 146 patients died. A study of these fatal cases, in which careful postmortems revealed lesions in some cases unsuspected during life, or in which the symptoms rendered a correct diagnosis a matter of the greatest difficulty, presents many interesting features.

Of the 146 patients, 11 died from other causes, such as diabetes and cardiac disease. In the remaining 135 patients, death was more or less directly referable to the temporal-bone disease. 11 patients died from exhaustion; 10 of these were wasted infants under one year of age; all had very extensive mastoid disease and subnormal temperature after operation, and died of inanition in from ten to thirty days afterward. In young children with defective stamina, it is certainly wiser not to aim at complete removal of all disease at one operation; the establishment of good drainage and the removal of the more serious disease should be accomplished at the first stage, and at a later period, a more complete and satisfactory radical operation performed.

In 22 cases, acute miliary tuberculosis caused a fatal issue; in 18, the meninges were affected and the symptoms those of tuberculous meningitis. In 8 of the 22 cases some other primary forms were present, but in the remaining 14 the temporal-bone disease seemed to be the sole focus of infection; 19 patients were under two years of age; in every case either symptoms of tuberculous meningitis or distinct evidence of general tuberculosis were present before operation, and in no case could the operation be regarded as the originating cause of a general disseminated miliary tuberculosis. In 5 patients when admitted an ordinary catarrhal pneumonia complicated an acute mastoid disease following upon chronic otorrhœa, the pneumonia proving fatal. In 3 cases an extradural abscess, situated over the sigmoid sinus, was evacuated during the mastoid operation, death subsequently ensuing from septic bronchopneumonia. In these cases rigors and remittent temperature had preceded operation, but the sinus was found to contain fluid blood. No septic thrombus or alteration in the vessel wall was found postmortem, although the infection must clearly have been conveyed through the sinus. No uncomplicated case of extradural abscess resulted fatally.

Of the remaining 93 cases, serous meningitis was present in 1, general meningitis in 33, meningitis and sigmoid sinus thrombosis in 10, meningitis and cerebellar abscess in 5, meningitis and temporosphenoidal

abscess in 6, sigmoid sinus thrombosis alone in 1, with pneumonia in 9, with cerebellar abscess in 7, temporosphenoidal abscess and thrombosis of the petrosal sinus in 1, temporosphenoidal abscess alone in 8, temporosphenoidal abscess and cerebellar abscess in 2, and cerebellar abscess alone in 10.

In the 17 cases of temporosphenoidal abscess, intense headache was present in all, vomiting in 13, drowsiness deepening to coma in 10, optic neuritis in 5.

In the 9 uncomplicated cases, temperature and pulse were subnormal in 2, in the cases with meningitis the rate was much above normal, and in the 2 cases with cerebellar abscess subnormal. In the 6 cases with meningitis, delirium and restlessness were present. In only 1 case, and that one of the uncomplicated ones, was the pupil on the affected side dilated and fixed. In 4 of the 22 cases the patellar reflexes could not be elicited. Sudden death occurred in 2 of the uncomplicated cases. In no case was an acute mastoid abscess present. One of the cases with meningitis had rigors and developed a septic bronchopneumonia. Among the 21 cases of cerebellar abscess, headache was present in 19, vertigo in 5, vomiting in 13, drowsiness in 11, optic neuritis in 3, subnormal temperature and slow pulse in 3, constipation in 4. Rigors occurred twice in the cases with meningitis and twice in those with latera sinus thrombosis. In the group with meningitis, delirium, restlessness, and muscular twitchings were a conspicuous feature. Sudden death occurred in 4 of the 10 uncomplicated cases, and in 1 other respiration ceased during the operation, and, although the heart was kept going for several hours, spontaneous breathing was never re-established. In 10 of the 21 cases an external mastoid abscess was present. Pupils were unequal in 1, nystagmus present in 3. The patellar reflexes never exaggerated, in 2 cases not obtainable. Of the 20 cases of sigmoid sinus thrombosis rigors were present in 14, high and often remittent temperature in all, headache in 7, optic neuritis in 5, vomiting in 9. Of the 33 cases of meningitis, headache was present in 21, vomiting in 12, mental excitement and delirium in 16, drowsiness in 9, muscular twitchings in 12, convulsions in 10, pupils dilated in 2, unequal in 3, optic neuritis in 8, elevated and fluctuating temperature in 21. Increased patellar reflex in 2, absent in 3; conjugate deviation of the eyes from the affected side in 3, toward the affected side in 2. External mastoid abscess was present in 17. The absence of the classical symptoms was a striking feature of these cases, but the author especially mentions the fact that this was not due to omission to note symptoms; in nearly all the cases definite mention having been made of the absence of symptoms of intracranial complications when they might have been expected. Headache was almost uniformly present in those cases in which a brain abscess was present. Vomiting was very frequently noted, but was absent in half the cases of uncomplicated cerebellar abscess. Drowsiness or coma was about equally frequent in cerebral and cerebellar abscess. Optic neuritis was more frequently observed in cerebral than in cerebellar abscess, and was rather remarkably common in the cases of meningitis, being present in eight out of thirty-three. Subnormal temperature and slow pulse were comparatively infrequent, being found in only 8 cases of abscess out of 38. Infection of the sigmoid sinus and

meningitis were almost invariably associated with high temperature, and in the former group the usual remittent temperature was found in all but 2 cases. The condition of the pupils was rarely an aid to diagnosis; in only one case of temporosphenoidal abscess was the typical dilated pupil on the side of the lesion present. Conjugate deviation of the eye was not present in any of the cases of cerebellar abscess, although found in 1 case of cerebral abscess with meningitis, and in 5 cases of simple meningitis. Nystagmus occurred in 3 cases of cerebellar abscess. The patellar reflexes were absent in 4 cases of cerebral abscess and in 2 of cerebellar. Delirium, muscular twitchings, contractions, or convulsions were almost uniformly present in all the cases in which meningitis caused death. Rigors occurred in 16 out of the 26 cases of thrombosis of the sigmoid sinus, but were never observed in any uncomplicated case of cerebral or cerebellar abscess, and in only 1 case of meningitis. There was an antecedent history of chronic otorrhœa in 21 out of the 33 cases of meningitis; in 17 out of the 20 cases of sinus thrombosis; in 20 out of 21 cases of cerebellar abscess; in 13 out of the 15 cases of cerebellar abscess, and in 1 out of the 2 cases of combined cerebral and cerebellar abscess. External mastoid signs were never observed in association with temporosphenoidal abscess, but occurred in about half the cases in which cerebellar abscess or meningitis caused death. Examinations of the cerebrospinal fluid obtained through a lumbar puncture, and of the blood, were made in a number of instances, but were never found to be of diagnostic significance in the early stages of those cases in which the diagnosis was uncertain. Positive indications were only obtained when the diagnosis was beyond doubt.

PATHOLOGY AND BACTERIOLOGY.

UNDER THE CHARGE OF

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Disease of the Arteries in the Course of Acute Infections.—Compared to the care which has been given to the study of the heart muscle in acute infectious diseases, the changes in the peripheral arteries, except for a few scattered observations, have been practically neglected. The subject has been dealt with most satisfactorily by Simnitzky, who has recently discussed the question of arterial sclerosis in the young. In a previous communication WIESEL has described degenerative changes in the peripheral vessels in typhoid fever, which are encountered more frequently and appear more extensive than the lesions in the myocardium. In a second communication from Kretz's laboratory (*Ztschr.*

f. Heilkunde, 1906, xxvii, 262) Wiesel describes the changes which he has observed in the peripheral vessels of young people, and even children and infants, dying from various acute infectious diseases. All parts of the peripheral arterial vascular system were examined. Eighty cases of diphtheria were studied, eighty of scarlet fever, and many cases of other infectious diseases. In all cases he found constantly a disease of the peripheral vessels that manifests itself as a degeneration of the smooth musculature and of the elastic fibers, which is to be seen first in the middle coat and in the majority of cases is confined to this one tunic. The degeneration appears in localized areas which in certain vessels may be very numerous, and in severe cases leads to a veritable necrosis of the vessel wall. These necroses heal either through scarring or by *restitutio ad integrum*. In many cases, however, the process extends into the intima, in which case this coat undergoes sclerotic changes, whereby permanent injury is produced. Though these changes are usually of microscopic nature, in extreme cases they may be visible to the naked eye. The disease affects all arterial vessels down to those of the caliber of the digital arteries. The exact localization varies in different cases, but the vessels most constantly diseased are the aorta, the cerebral and coronary arteries. In general, the lesions may be classed in two groups: those in which the elastic fibers are involved principally, and those in which the musculature receives the brunt of the injury. Lesions of the first type are found in diphtheria, typhoid fever, influenza, and pneumonia, and Wiesel considers that they are produced by bacterial poisons; the second variety of lesion is seen in scarlet fever and the septic pyemic diseases.

The Bacterial Contents of the Nose in Infectious Diseases, with Special Reference to Epidemic Cerebrospinal Meningitis.—Hasslauer (*Centr. f. Bakt.*, orig., 1906, xxxxi, 796) has investigated the nasal flora in healthy persons, exposed and unexposed to infectious disease, and in persons suffering from epidemic cerebrospinal meningitis and other infectious diseases. He believes that most organisms which enter the nose with the air current are arrested in the anterior parts, where they may be overgrown by saprophytes, and usually cause no harm. A primary or secondary rhinitis may occur in the course of acute infections which is quite analogous to middle-ear disease occurring in these conditions. Hasslauer isolated the meningococcus from the posterior nares of patients suffering from epidemic meningitis. A rhinitis may or may not be present in these cases. The organism was obtained from apparently healthy mucosa. Cultural and agglutination methods were used for the identification of the organism, and the author emphasizes the importance of these procedures for the accurate diagnosis of the meningococcus.

The meningococcus was not found in twenty persons unexposed to the disease, but it was isolated from nine apparently healthy persons who had been in close contact with meningitic patients. The presence of the organism in some of these cases produced no apparent ill effects, but Hasslauer believes such individuals are important factors in spreading the disease. He concludes that the nose is the portal of entry for the meningococcus, and considers it likely that it is carried from the nose to the brain by the blood stream. As argument for this he cites the fact that the organism is not infrequently found in the circulating blood, especially early in the disease. He was able to isolate it from the

circulation four times. After treating the healthy meningococcus carriers with an antiseptic powder used as snuff, no cases of meningococcus arose from them, as far as could be traced.

A Study of the So-called Infectious Lymphosarcoma of Dogs.—BEEBE and EWING (*Jour. Med. Research*, 1906, xv, 209) have made an extensive study of this interesting malignant tumor which occurs in dogs, and is transmitted from one animal to the other through coitus. The primary growths are found on the genitals of dogs, and metastases may occur in many organs of the body. The tumor is, however, not especially malignant. Microscopically it closely resembles large-cell lymphosarcoma of man. The cells resemble the large proliferating cells of lymph follicles, but are polygonal more often than round, not arranged in alveoli, and are supported by thin strands of connective tissue. Beebe and Ewing do not attempt an exact histological classification of the tumor, but the general histological characteristics suggest to them the diagnosis of alveolar sarcoma or endothelioma. Many implantation experiments were performed. Small subcutaneous grafts and subcutaneous injections of suspensions of tumor cells were used. With one tumor all of the animals in which the first method was used developed typical tumors in three to five weeks. The second method gave negative results. The authors found that old dogs were more susceptible than young ones. Spontaneous cures resulted in some cases. They were unable to reinfect four animals in which recovery had taken place. The general health of the dogs seemed to have a rough relationship to their susceptibility. Recovery usually took place in vigorous well-nourished, young dogs. In multiple inoculations all tumors showed the same rapidity of growth or regression. The crucial point which Beebe and Ewing endeavor to settle is, whether, after grafting the tumor, the new-growth arises from the transplanted tissue, or whether its origin is from the surrounding tissue, as claimed by others. By making histological studies of transplanted tumors and the surrounding tissue at varying intervals after grafting, the authors conclude that although the central portions of the transplanted material usually dies, small islands of tumor tissue remain alive, from which the new tumor growths arise. Their experience leads them to agree with Sticker, that the infectious lymphosarcoma of dogs is a true malignant neoplasm and not a granuloma. They present no evidence of a parasitic cause for the tumor, and believe that if it is due to a parasite the parasite has so vital and intimate a relationship with the tumor cell that it is impossible by their experiments to make any distinction between them.

The Origin of Blood Platelets.—Though many explanations have been offered to account for the origin of blood platelets, none seems to have gained general acceptance, and WRIGHT (*Virchow's Archiv.*, 1906, clxxix, 55), who has made an extensive comparative study of blood platelets in a large series of animals, considers that all the theories hitherto advanced are wrong. Wright's studies go to show that the blood platelets are derived from the protoplasm of the giant cells of the bone-marrow and spleen. These giant cells are the "megokaryocytes" of Howell. By a special technique he has been able to stain blood platelets in fixed tissue. The differentiation is eventually the same as that obtained with the modified Leishman-Romanowsky stains;

the central granular part of the platelet takes a red or violet stain, the peripheral hyaline portion a blue stain. With this stain the giant cells present a characteristic appearance. There is a central portion which forms the principal part of the cytoplasm, and is made up of small granules which stain red, and a narrow peripheral zone of hyaline protoplasm that stains blue. The gaint cells being amœboid throw out pseudopodia, which are composed chiefly of the outer hyaline cytoplasm, but show in the central part masses of the pink granules. The pseudopodia are sometimes seen projecting into bloodvessels. Pieces are pinched off the end of pseudopods, or whole pseudopodia may be seen lying free near a cell. These pseudopodia are, in their staining reactions, precisely like plates, while the pinched-off pieces cannot be told from platelets. By this pseudopod formation and pinching off process the entire protoplasm of a cell may be lost, leaving a naked nucleus lying in the midst of the cell remnants. Wright believes that the platelets are formed from the protoplasm of the giant cells in this manner. To uphold this theory Wright gives further arguments in its favor. Thus blood platelets occur only in mammals, animals which have giant cells in their bone-marrows. Wright has demonstrated platelets in all mammals of the different orders except the opossum and the camel, and except in the opossum has found giant cells in the marrows of all mammals examined. The so-called spindle cells of the birds, amphibia, and reptiles are analogous, not to the platelets, but to the giant cells of mammals. Further, the blood platelets appear in the blood of the embryo at the time when the giant cells appear in the marrow. The results of blood-platelet counts in the human being in various diseases go to show that the platelets are increased when the giant cells of the marrow are increased, and *vice versa*.

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